(3)

JAPANESE [JP,2002-112321,A]

[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] The amount of data [in / on the communication device which communicates with two or more wireless terminals, and / the transmitting side for said every wireless terminal] which should transmit, An allocation sequence decision means to determine the allocation sequence of the communication line between said communication devices and said wireless terminals based on the communication link quality in the receiving side for said every wireless terminal, The communication device characterized by having the communication line allocation means which assigns the communication line between said communication devices and said wireless terminals according to said determined allocation sequence.
[Claim 2] The maximum residence time of the data [in / on the communication device which communicates with two or more wireless terminals, and / the transmitting side for said every wireless terminal] which should be transmitted, An allocation sequence decision means to determine the allocation sequence of the communication line between said communication devices and said wireless terminals based on the communication link quality in the receiving side for said every wireless terminal, The communication device characterized by having the communication line allocation means which assigns the communication line between said communication devices and said wireless terminals according to said determined allocation sequence.
[Claim 3] Said allocation sequence decision means is a communication device characterized by determining the allocation sequence of said communication line based on the maximum residence time of the data which were measured [in / when said communication device is a transmitting side in a communication device according to claim 2 / said communication device] and which should be transmitted, and the communication link quality measured in said each wireless terminal.
[Claim 4] Said allocation sequence decision means is a communication device characterized by determining the allocation sequence of said communication line based on the communication link quality measured [in / when said communication device is a receiving side in a communication device according to claim 2 / said communication device], and the maximum residence time of the data which were measured in said each wireless terminal and which should be transmitted.
[Claim 5] The 1st wireless terminal with which the maximum residence time of the data which should be transmitted, or the data which should be received exceeded predetermined time in the communication device given in any [claim 2 thru/or] of 4 they are, It has a wireless terminal classification means to classify into the 2nd wireless terminal with which the maximum residence time of the data which should be transmitted, or the data which should be received does not exceed predetermined time. Said allocation sequence decision means While giving priority over said 2nd wireless terminal and determining the allocation sequence of said communication line to said 1st wireless terminal, about said 1st wireless terminal The allocation sequence of said communication line is determined as descending of the maximum residence time of said data which should be transmitted, or the data which should be received, and the good order of said communication link quality. About said 2nd wireless terminal The communication device characterized by determining the allocation sequence of said communication line as descending

of the maximum residence time of the good order of said communication link quality, said data which should be transmitted, or the data which should be received.
[Claim 6] It is the communication device characterized by said allocation sequence decision means determining the allocation sequence of said communication line in a communication device according to claim 2 based on said maximum residence time of the data which should be transmitted and amount of data, and said communication link quality.
[Claim 7] The 1st wireless terminal with which the maximum residence time of the data which should be transmitted, or the data which should be received exceeded predetermined time in the communication device according to claim 6, It has a wireless terminal classification means to classify into the 2nd wireless terminal with which the maximum residence time of the data which should be transmitted, or the data which should be received does not exceed predetermined time. Said allocation sequence decision means While giving priority over said 2nd wireless terminal and determining the allocation sequence of said communication line to said 1st wireless terminal, about said 1st wireless terminal Descending of the maximum residence time of said data which should be transmitted, or the data which should be received, The allocation sequence of said communication line is determined as order with little the good order of said communication link quality, said amount of data which should transmit, or the amount of data which should receive. About said 2nd wireless terminal The communication device characterized by determining the allocation sequence of said communication line as descending of the maximum residence time of order with little the good order of said communication link quality, said amount of data which should transmit, or the amount of data which should receive, said data which should be transmitted, or the data which should be received.
[Claim 8] In a communication device given in any [claim 1 thru/or] of 7 they are said allocation sequence decision means Instead of determining the allocation sequence of the communication line between said communication devices and said wireless terminals based on the communication link quality in the receiving side for said every wireless terminal The communication device characterized by determining the allocation sequence of the communication line between said communication devices and said wireless terminals based on the number of modulation multiple values of the digital modulation method corresponding to the communication link quality in the receiving side for said every wireless terminal.
[Claim 9] In the communication line allocation approach in the communication device which communicates with two or more wireless terminals The procedure of determining the allocation sequence of the communication line between said communication devices and said wireless terminals based on the amount of data in the transmitting side for said every wireless terminal which should transmit, and the communication link quality in the receiving side for said every wireless terminal, The communication line allocation approach characterized by having the procedure which assigns the communication line between said communication devices and said wireless terminals according to said determined allocation sequence.
[Claim 10] In the communication line allocation approach in the communication device which communicates with two or more wireless terminals The maximum residence time of the data in the transmitting side for said every wireless terminal which should be transmitted, The procedure of determining the allocation sequence of the communication line between said communication devices and said wireless terminals based on the communication link quality in the receiving side for said every wireless terminal, The communication line allocation approach characterized by having the procedure which assigns the communication line between said communication devices and said wireless terminals according to said determined allocation sequence.
[Claim 11] The procedure of determining said allocation sequence when said communication device is a transmitting side in the communication line allocation approach according to claim 10 is the communication line allocation approach characterized by determining the allocation sequence of said communication line based on the maximum residence time of the data which were measured in said communication device and which should be transmitted, and the communication link quality measured in said each wireless terminal.
[Claim 12] The procedure of determining said allocation sequence when said communication device is a receiving side in the communication line allocation approach according to claim 10 is

the communication line allocation approach characterized by determining the allocation sequence of said communication line based on the communication link quality measured in said communication device, and the maximum residence time of the data which were measured in said each wireless terminal and which should be transmitted.
[Claim 13] The 1st wireless terminal with which the maximum residence time of the data which should be transmitted, or the data which should be received exceeded predetermined time in the communication line allocation approach given in any [claim 10 thru/or] of 12 they are, The procedure of having the procedure classified into the 2nd wireless terminal with which the maximum residence time of the data which should be transmitted, or the data which should be received does not exceed predetermined time, and determining said allocation sequence While giving priority over said 2nd wireless terminal and determining the allocation sequence of said communication line to said 1st wireless terminal, about said 1st wireless terminal The allocation sequence of said communication line is determined as descending of the maximum residence time of said data which should be transmitted, or the data which should be received, and the good order of said communication link quality. About said 2nd wireless terminal The communication line allocation approach characterized by determining the allocation sequence of said communication line as descending of the maximum residence time of the good order of said communication link quality, said data which should be transmitted, or the data which should be received.
[Claim 14] It is the communication line allocation approach characterized by said procedure which makes an allocation sequence decision determining the allocation sequence of said communication line in the communication line allocation approach according to claim 10 based on said maximum residence time of the data which should be transmitted and amount of data, and said communication link quality.
[Claim 15] The 1st wireless terminal with which the maximum residence time of the data which should be transmitted, or the data which should be received exceeded predetermined time in the communication line allocation approach according to claim 14, The procedure of having the procedure classified into the 2nd wireless terminal with which the maximum residence time of the data which should be transmitted, or the data which should be received does not exceed predetermined time, and determining said allocation sequence While giving priority over said 2nd wireless terminal and determining the allocation sequence of said communication line to said 1st wireless terminal, about said 1st wireless terminal Descending of the maximum residence time of said data which should be transmitted, or the data which should be received, The allocation sequence of said communication line is determined as order with little the good order of said communication link quality, said amount of data which should transmit, or the amount of data which should receive. About said 2nd wireless terminal The communication line allocation approach characterized by determining the allocation sequence of said communication line as descending of the maximum residence time of order with little the good order of said communication link quality, said amount of data which should transmit, or the amount of data which should receive, said data which should be transmitted, or the data which should be received.
[Claim 16] In the communication line allocation approach given in any [claim 9 thru/or] of 15 they are, the procedure of determining said allocation sequence Instead of determining the allocation sequence of the communication line between said communication devices and said wireless terminals based on the communication link quality in the receiving side for said every wireless terminal The communication line allocation approach characterized by determining the allocation sequence of the communication line between said communication devices and said wireless terminals based on the number of modulation multiple values of the digital modulation method corresponding to the communication link quality in the receiving side for said every wireless terminal.

[Translation done.]

* NOTICES *

JPO and INPIT are not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a communication device and the communication line allocation approach.
[0002]
[Description of the Prior Art] In the radio communications system whose service with voice was a subject, the demand to the so-called multimedia service of the data communication of not only voice but a non-voice, download of a dynamic image and a static image, etc. has been increasing in recent years. For this reason, offer of multimedia service is indispensable to a future radio communications system.
[0003] When realizing such multimedia service, since a communication link far more nearly high-speed than the case of an audio communication link is required, the design of the system which performs efficient transmission which used the communication line effectively is called for. For that purpose, it becomes important by controlling communication link quality to aim at a deployment of a resource.
[0004] The approach based on the amount of data by which the communications control for aiming at such efficient transmission conventionally was stored in the buffer, and the time delay permitted, or the approach based on the signal-to-noise power ratio (SN ratio) of an input signal was adopted. These examples are shown in drawing 16 and 17.
[0005] Drawing 16 is the amount of data stored in the buffer, and a flow chart which shows the communication line allocation approach based on the time delay permitted. In a Time Division Multiple Access, the communication line (channel) assigned to each communication terminal is called a time slot.
[0006] It judges whether the base transceiver station exceeded the time amount (an "allowed value" is called below) by which the elapsed time (a "time delay" is called below) after a packet is stored in each buffer is supervised, and this time delay is permitted (step 1501).
[0007] When the packet to which the time delay is over the allowed value exists, a base transceiver station assigns a time slot to descending of a time delay to each wireless terminal which receives the packet beyond the allowed value (step 1502). Next, a base transceiver station assigns a time slot to order with little amount of data in a buffer to the wireless terminal which receives the packet to which the time delay is not over the allowed value (step 1503).
[0008] Moreover, when the time delay of the packet in all buffers is not over the allowed value, a base transceiver station assigns a time slot to order with little amount of data in a corresponding buffer to each wireless terminal (step 1503). (when negative judgment is carried out at step 1501) In addition, in step 1503, it is because the number of time slots of assign [order with little amount of data in a buffer / a time slot] occupied if there is little amount of data also decreases, so the increment in the number of wireless terminals connectable with coincidence can be expected.
[0009] Thus, by assigning a time slot preferentially to the wireless terminal which receives the packet to which the time delay exceeded the allowed value, it can prevent that a time delay increases and efficient transmission can be performed.

[0010] On the other hand, drawing 17 is a flow chart which shows the communication line allocation approach based on the SN ratio of an input signal. A base transceiver station always observes the receiving SN ratio sent from each wireless terminal (step 1601), and assigns a time slot sequentially from a wireless terminal with this high receiving SN ratio (step 1602).
[0011] Thus, when possibility that a bit error, a packet error, etc. after receiving since communication link quality has deteriorated will arise is high, as a receiving error is not started if possible, efficient transmission can be performed by making low the priority of assignment of the time slot to a corresponding wireless terminal.
[0012]
[Problem(s) to be Solved by the Invention] However, by the amount of data stored in the buffer shown in drawing 16 , and the communication line allocation approach based on a time delay, since communication link quality is not taken into consideration, the following problems arise.
[0013] For example, communication link quality deteriorates for sharp fluctuation of radio-wave-propagation ways, such as shadowing, and considering the case where a packet error occurs in a receiving side, a time slot is again assigned by the approach shown in drawing 16 that the packet which that error produced should be resent in this case. However, by degradation of communication link quality, even if it assigns a time slot again, a packet error arises again. Consequently, the amount of data which can be transmitted and received correctly, i.e., a throughput, will fall to per unit time amount, and the transmission efficiency in the whole system will fall.
[0014] On the other hand, by the communication line allocation approach based on the SN ratio of an input signal shown in drawing 17 , since the time delay is not taken into consideration, even if the demand to delay is severe, priority is not given to assignment of a time slot to the wireless terminal in the condition that communication link quality has deteriorated. For this reason, although the demand to delay is a severe wireless terminal, even if it connects, the situation of being as being cut on the way **** [, and] arises, and the problem that delay increases arises. [that connection with a base transceiver station cannot be performed]
[0015] This invention being made in view of the problem mentioned above, and aiming at a deployment of a communication line, it is held down to below the value of a request of a time delay, and aims at improving a throughput.
[0016]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the communication device of this invention The amount of data [in / it communicates with two or more wireless terminals so that it may be indicated by claim 1, and / the transmitting side for said every wireless terminal] which should transmit, An allocation sequence decision means to determine the allocation sequence of the communication line between said communication devices and said wireless terminals based on the communication link quality in the receiving side for said every wireless terminal, According to said determined allocation sequence, it has the communication line allocation means which assigns the communication line between said communication devices and said wireless terminals.
[0017] Based on the amount of data in the transmitting side for every wireless terminal which should transmit, by determining the allocation sequence of a communication line, a communication line can be assigned preferentially between the communication devices with little amount of data and wireless terminals which communicate, and the wireless terminal which does not have a problem in the residence time etc. can be increased by making the number of wireless terminals linked to coincidence increase with such a communication device. By combining and determining the allocation sequence of a communication line based on the communication link quality in the receiving side for every wireless terminal, data can be preferentially communicated between the good communication device of communication link quality, and a wireless terminal, and a throughput can be raised by decreasing the retry count of data. In addition, a communication line means the time slot in a Time Division Multiple Access method, the frequency band in a Frequency-Division-Multiplexing access method, the diffusion code in Code Division Multiple Access, etc.
[0018] Moreover, the maximum residence time of the data [in / the communication device of

this invention communicates with two or more wireless terminals so that it may be indicated by claim 2, and / the transmitting side for said every wireless terminal] which should be transmitted, An allocation sequence decision means to determine the allocation sequence of the communication line between said communication devices and said wireless terminals based on the communication link quality in the receiving side for said every wireless terminal, According to said determined allocation sequence, it has the communication line allocation means which assigns the communication line between said communication devices and said wireless terminals.

[0019] Based on the maximum residence time of the data in the transmitting side for every wireless terminal which should be transmitted, by determining the allocation sequence of a communication line, the large data of the residence time can be transmitted preferentially and the residence time can be improved in such a communication device. By combining and determining the allocation sequence of a communication line based on the communication link quality in the receiving side for every wireless terminal, data can be preferentially communicated between the good communication device of communication link quality, and a wireless terminal, and a throughput can be raised by decreasing the retry count of data.
[0020] Moreover, invention which invention indicated by claim 3 specified the case where said communication device was a transmitting side, and was indicated by claim 4 specifies the case where said communication device is a receiving side.
[0021] Moreover, the 1st wireless terminal with which the maximum residence time of the data which should be transmitted, or the data which should be received exceeded predetermined time so that this invention might be indicated by claim 5, It has a wireless terminal classification means to classify into the 2nd wireless terminal with which the maximum residence time of the data which should be transmitted, or the data which should be received does not exceed predetermined time. Said allocation sequence decision means While giving priority over said 2nd wireless terminal and determining the allocation sequence of said communication line to said 1st wireless terminal, about said 1st wireless terminal The allocation sequence of said communication line is determined as descending of the maximum residence time of said data which should be transmitted, or the data which should be received, and the good order of said communication link quality. About said 2nd wireless terminal By determining the allocation sequence of said communication line as descending of the maximum residence time of the good order of said communication link quality, said data which should be transmitted, or the data which should be received Since a communication line is assigned to descending of the maximum residence time about the large thing of the maximum residence time and a communication line is assigned to the good order of communication link quality about the small thing of the maximum residence time, A communication line can be assigned aiming at harmony with an improvement of the residence time and improvement in a throughput.
[0022] Moreover, said allocation sequence decision means determines the allocation sequence of said communication line based on said maximum residence time of the data which should be transmitted and amount of data, and said communication link quality so that this invention may be indicated by claim 6. In this case, a communication line can be assigned preferentially between the communication devices with little amount of data and wireless terminals which communicate, and the wireless terminal which does not have a problem in the residence time etc. can be increased by making the number of wireless terminals linked to coincidence increase.

[0023] The 1st wireless terminal with which the maximum residence time of the data which should be transmitted, or the data which should be received exceeded predetermined time so that it might be especially indicated by claim 7, It has a wireless terminal classification means to classify into the 2nd wireless terminal with which the maximum residence time of the data which should be transmitted, or the data which should be received does not exceed predetermined time. Said allocation sequence decision means While giving priority over said 2nd wireless terminal and determining the allocation sequence of said communication line to said 1st wireless terminal, about said 1st wireless terminal Descending of the maximum residence time of said data which should be transmitted, or the data which should be received, The allocation sequence

of said communication line is determined as order with little the good order of said communication link quality, said amount of data which should transmit, or the amount of data which should receive. About said 2nd wireless terminal By determining the allocation sequence of said communication line as descending of the maximum residence time of order with little the good order of said communication link quality, said amount of data which should transmit, or the amount of data which should receive, said data which should be transmitted, or the data which should be received A communication line can be assigned like invention indicated by claim 5, aiming at harmony with an improvement of the residence time and improvement in a throughput, it can combine, and the wireless terminal which does not have a problem in the residence time etc. can be increased by making the number of wireless terminals linked to coincidence increase.

[0024] This invention so that it may be indicated by claim 8 moreover, said allocation sequence decision means Instead of determining the allocation sequence of the communication line between said communication devices and said wireless terminals based on the communication link quality in the receiving side for said every wireless terminal Based on the number of modulation multiple values of the digital modulation method corresponding to the communication link quality in the receiving side for said every wireless terminal, by determining the allocation sequence of the communication line between said communication devices and said wireless terminals The allocation sequence of a communication line as well as the case where communication link quality is used can be determined using the number of modulation multiple values.

[0025] Moreover, invention indicated by claims 9-16 is the communication line allocation approach of having been suitable for the communication device indicated by claims 1-8.

[0026]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained based on a drawing. Drawing 1 is drawing showing the fundamental configuration of the radio communications system with which the communication device concerning the gestalt of operation of this invention and the communication line allocation approach are applied.

[0027] In the radio communications system shown in this drawing, a communication link is performed between one base transceiver station 1 and each wireless terminals 10, 20, 30, and 40. On the occasion of the communication link between this base transceiver station 1 and each wireless terminals 10-40, control which a base transceiver station 1 assigns the time slot in a Time Division Multiple Access method to each wireless terminals 10-40 is performed.

[0028] The base transceiver station 1 is equipped with the buffers 11, 21, 31, and 41 for several wireless terminal minutes connected. The packet transmitted to the wireless terminal 10 is stored in a buffer 11. Similarly, the packet transmitted to the wireless terminals 20-40 is stored in buffers 21-41. On the other hand, each wireless terminals 10-40 are equipped with the buffers 12, 22, 32, and 42 which store the packet transmitted to a base transceiver station 1.

[0029] In case drawing 2 transmits a packet to each wireless terminals 10-40 from a base transceiver station 1, it is the block diagram of the processing which assigns a time slot to each wireless terminals 10-40.

[0030] In a receive section 202, each wireless terminals 10-40 have received the signal transmitted from a base transceiver station 1, measure the SN ratio (receiving SN ratio) of this input signal in the SN ratio test section 204, and transmit it to a base transceiver station 1. This receiving SN ratio shows the communication link quality of the communication line which transmits data to each wireless terminals 10-40 from a base transceiver station 1.

[0031] A base transceiver station 1 measures the amount of data stored in the buffers 11-41 in a base transceiver station 1 in the amount-of-data test section 206. Moreover, in the maximum residence-time test section 208, the residence time (the "maximum residence time" is called below) of the packet which is piling up for a long time about each of buffers 11-41 is measured.

[0032] In the slot allocation priority foreword decision processing section 212, three parameters of the amount of data of the buffers 11-41 measured by the receiving SN ratio in the wireless terminals 10-40 and the amount-of-data test section 206 and the maximum residence time of the packet in the buffer 11-41 measured by the maximum residence-time test section 208 are

used, in case the allocation sequence of the time slot to each wireless terminals 10-40 is determined. However, before determining allocation sequence, it classifies into the wireless terminal which transmits the packet in the wireless terminal which transmits the packet in the buffer with which the maximum residence time exceeded predetermined allowed time for each wireless terminals 10-40, and the buffer with which the maximum residence time does not exceed predetermined allowed time in the classification processing section 210 by the maximum residence time.

[0033] Allocation sequence is the following, and is made and determined. In the slot allocation sequence decision processing section 210 About the wireless terminal which receives the packet in the buffer with which the maximum residence time exceeded predetermined allowed time Descending of the maximum residence time of the buffer which corresponds the allocation sequence of a time slot, It is decided that they will be corresponding descending of a receiving SN ratio and order with little amount of data of a corresponding buffer. then, about the wireless terminal which receives the packet in the buffer with which the maximum residence time does not exceed predetermined allowed time The allocation sequence of a time slot is determined as corresponding descending of a receiving SN ratio, order with little amount of data of a corresponding buffer, and descending of the maximum residence time of the packet in a corresponding buffer.

[0034] Thus, after the allocation sequence of a time slot is determined to all the wireless terminals 10-40, in the slot allocation processing section 314, processing which assigns a time slot to each wireless terminals 10-40 according to this allocation sequence is performed, and the packet stored in buffers 11-41 is transmitted to each wireless terminals 10-40 in the transmitting section 316 using the assigned time slot.

[0035] On the other hand, in case drawing 3 transmits a packet to a base transceiver station 1 from each wireless terminals 10-40, it is the block diagram of the processing which assigns a time slot to each wireless terminals 10-40.

[0036] Each wireless terminals 10-40 have transmitted the predetermined signal to the base transceiver station 1 in the transmitting section 301. Moreover, in the amount-of-data test section 306, the amount of data of the buffers 12-42 to build in is measured, and it transmits to a base transceiver station 1. In the maximum residence-time test section 308, the residence time (the maximum residence time) of the packet which is piling up for a long time in the buffer 12-42 to build in is measured, and it transmits to a base transceiver station 1.

[0037] A base transceiver station 1 measures an SN ratio for every wireless terminal in the SN ratio test section 304 about the signal received from each wireless terminals 10-40. This receiving SN ratio shows the communication link quality of the communication line which transmits data to a base transceiver station 1 from each wireless terminals 10-40.

[0038] In the slot allocation priority foreword decision processing section 312, the maximum residence time of the packet in the buffer 12-42 sent from the receiving SN ratio in the wireless terminals 10-40 measured by the SN ratio test section 304 and each wireless terminals 10-40 and three parameters of the amount of data are used, in case the allocation sequence of the time slot to each wireless terminals 10-40 is determined. However, before determining allocation sequence, it classifies into the wireless terminal which receives the packet in the wireless terminal which receives the packet in the buffer with which the maximum residence time exceeded predetermined allowed time for each wireless terminals 10-40, and the buffer with which the maximum residence time does not exceed predetermined allowed time in the classification processing section 310 by the maximum residence time.

[0039] Allocation sequence is the following, and is made and determined. In the slot allocation sequence decision processing section 312 About the wireless terminal which receives the packet in the buffer with which the maximum residence time exceeded predetermined allowed time like the slot allocation sequence decision processing section 212 shown in drawing 2 Descending of the maximum residence time of the packet in the buffer which corresponds the allocation sequence of a time slot, It is decided that they will be corresponding descending of a receiving SN ratio and order with little amount of data of a corresponding buffer. then, about the wireless terminal which receives the packet in the buffer with which the maximum residence time does

not exceed predetermined allowed time The allocation sequence of a time slot is determined as corresponding descending of a receiving SN ratio, order with little amount of data of a corresponding buffer, and descending of the maximum residence time of the packet in a corresponding buffer.
[0040] Thus, if the allocation sequence of a time slot is determined to all the wireless terminals 10-40, in the slot allocation processing section 314, processing which assigns a time slot to each wireless terminals 10-40 according to this allocation sequence will be performed. Each wireless terminals 10-40 transmit the packet stored in the buffers 12-42 to build in to a base transceiver station 1 using the assigned time slot.
[0041] The flow chart of priority foreword decision processing of the slot allocation in the operation gestalt of drawing 2 and drawing 3 which were mentioned above is shown in drawing 4 .

[0042] After acquiring three parameters of the amount of data in a receiving SN ratio and a buffer, and the maximum residence time The wireless terminal which receives or transmits the packet in the buffer with which the maximum residence time exceeded allowed time ("the wireless terminal with which the maximum residence time exceeded allowed time" is called below), Even the processing which classifies the packet in the buffer which has not exceeded into the wireless terminal ("the wireless terminal with which the maximum residence time does not exceed allowed time" is called below) received or transmitted is the 1st step. Then, in the 2nd step, allocation processing of a time slot based on three parameters of the amount of data in a receiving SN ratio and a buffer and the maximum residence time of a packet is performed.
[0043] Processing which will assign a time slot with the priority to the wireless terminal if the wireless terminal with which the maximum residence time exceeded allowed time exists so that clearly from drawing 4 is performed, and after that, if an empty slot still exists, processing which assigns a time slot to the wireless terminal with which the maximum residence time does not exceed allowed time will be performed. The flow of detailed processing of the wireless terminal with which the maximum residence time of a packet exceeded allowed time, and each wireless terminal which has not exceeded is shown in drawing 5 and drawing 6 . It is necessary to each wireless terminals 10-40 to grasp a base transceiver station 1 for every period which performs quality control for the amount of data accumulated into the maximum residence time of the packet in a buffer, and the present buffer. In addition, although it is with the case where it does not exceed with the case where the maximum residence time of a packet exceeds allowed time and the allocation sequence of the time slot in the 2nd step differs, the 1st-step processing in which a wireless terminal is classified in consideration of the maximum residence time of a packet in the case of which is the same.
[0044] The 1st-step processing in the operation gestalt of introduction drawing 4 is explained. The classification processing sections 210 and 310 by the maximum residence time judge whether the maximum residence time of a packet is over allowed time among three parameters of the amount of data in the acquired receiving SN ratio and a buffer, and the maximum residence time of a packet (step 401), and classify it into the wireless terminal with which the maximum residence time exceeded allowed time, and the wireless terminal which has not exceeded (steps 402 and 403).
[0045] Then, the 2nd-step processing is explained. First, processing to the wireless terminal with which the maximum residence time exceeded allowed time is performed (step 404). The detail of the processing to these wireless terminals is shown in drawing 5 .
[0046] The slot allocation priority foreword decision processing sections 212 and 312 sort each wireless terminal to descending of the maximum residence time so that they may assign a time slot with the priority to the large wireless terminal of the maximum residence time so that the time delay of a wireless terminal may not be increased (step 501). This sorted sequence turns into allocation sequence of a time slot.
[0047] However, two or more wireless terminals in which the maximum residence time has the same value may exist. Then, when it judges whether two or more wireless terminals in which the maximum residence time has the same value exist (step 502) and exists [two or more] it, about these wireless terminals, the slot allocation priority foreword decision processing sections 212

and 312 sort to descending of a receiving SN ratio (step 503), and determine the allocation sequence of a time slot.
[0048] Here, two or more wireless terminals which have the same value also about a receiving SN ratio may exist. Then, when it judges whether two or more wireless terminals in which a receiving SN ratio has the same value further exist (step 504) and exists [two or more] it, about these wireless terminals, the slot allocation priority foreword decision processing sections 212 and 312 sort in order with little amount of data in a buffer (step 505), and determine the allocation sequence of a time slot.
[0049] Thus, if it judges whether the slot allocation processing sections 214 and 314 have an empty slot (step 506) and there is an empty slot about all the wireless terminals with which the maximum residence time exceeded allowed time after the allocation sequence of a time slot is determined uniquely, processing which assigns the empty slot to a wireless terminal will be performed (step 507).
[0050] Judgment processing (step 506) of whether there are these empty slots and allocation processing (step 507) of a time slot are repeated until it assigns a time slot to all the wireless terminals with which the maximum residence time exceeded allowed time or an empty slot is lost. In addition, an empty slot assigns a time slot sequentially from what has the maximum residence time large when there is only no empty slot which transmits all the packets in the buffer of the transmitting side of a certain thing, and the slot allocation processing sections 214 and 314 end allocation processing (step 507) of a time slot, when an empty slot is lost.
[0051] Again, it returns and explains to drawing 4 . If it is judged after termination of the processing (step 404) to the wireless terminal with which the maximum residence time exceeded allowed time whether there is still any empty slot (step 405) and there is an empty slot, processing (step 406) to the wireless terminal with which the maximum residence time does not exceed allowed time will be performed. The detail of the processing to these wireless terminals is shown in drawing 6 .
[0052] The slot allocation priority foreword decision processing sections 212 and 312 sort each wireless terminal to descending of a receiving SN ratio so that a receiving SN ratio may assign a time slot preferentially to a large wireless terminal (step 601). This sorted sequence turns into allocation sequence of a time slot.
[0053] Since two or more wireless terminals in which a receiving SN ratio has the same value may exist, however, the slot allocation priority foreword decision processing sections 212 and 312 When it judges whether two or more wireless terminals in which a receiving SN ratio has the same value exist (step 602) and more than one exist it, about these wireless terminals, it sorts in order with little amount of data in a buffer (step 603), and the allocation sequence of a time slot is determined.
[0054] Since two or more wireless terminals which have the same value also about the amount of data in a buffer may exist here, the slot allocation priority foreword decision processing sections 212 and 312 When it judges whether two or more wireless terminals with a value with the still more nearly same amount of data in a buffer exist (step 604) and more than one exist it, about these wireless terminals, it sorts to descending of the maximum residence time (step 605), and the allocation sequence of a time slot is determined.
[0055] Thus, if it judges whether the slot allocation processing sections 214 and 314 have an empty slot (step 606) and there is an empty slot about all the wireless terminals with which the maximum residence time does not exceed allowed time after the allocation sequence of a time slot is determined uniquely, processing which assigns the empty slot to a wireless terminal will be performed (step 607). Judgment processing (step 606) of whether there are these empty slots and allocation processing (step 607) of a time slot are repeated until it assigns a time slot to all the wireless terminals with which the maximum residence time does not exceed allowed time or an empty slot is lost.
[0056] As explained to the detail above, based on the maximum residence time of a packet, the large packet of the residence time can be transmitted preferentially and the residence time can be improved. Moreover, based on a receiving SN ratio, a packet can be preferentially communicated between the base transceiver station 1 where this receiving SN ratio is good, and

a wireless terminal, and a throughput can be raised by decreasing the retry count of a packet. Furthermore, based on the amount of data in a buffer, a communication line can be assigned preferentially between the base transceiver station 1 with little amount of data with little amount of data which communicates, and a wireless terminal, and the wireless terminal which does not have a problem in the residence time can be increased by making the number of wireless terminals linked to coincidence increase.

[0057] By the way, based on the number of modulation multiple values, the allocation sequence of a time slot can also be determined instead of a receiving SN ratio. In case drawing 7 transmits a packet to each wireless terminals 10-40 from a base transceiver station 1, it is the block diagram of the processing which determines that the number of modulation multiple values will satisfy the communication link quality demanded, and assigns a time slot to each wireless terminals 10-40.

[0058] In a receive section 702, each wireless terminals 10-40 receive the signal transmitted from a base transceiver station 1 like the receive section 202 which showed drawing 2 , measure the SN ratio (receiving SN ratio) of this input signal in the SN ratio test section 704, and transmit it to a base transceiver station 1.

[0059] In the number decision section 705 of multiple values, in the receiving SN ratio sent from each wireless terminals 10-40, a base transceiver station 1 performs processing which lowers the number of modulation multiple values, when not judging and satisfying whether the communication link quality (for example, a bit error rate and a packet error rate) demanded can be satisfied.

[0060] The number of modulation multiple values for every wireless terminal 10-40 determined by the number decision section 705 of multiple values, The amount of data of the buffers 11-41 measured by the amount-of-data test section 706, In the slot allocation priority foreword decision processing section 712, three parameters of the maximum residence time of the packet in the buffer 11-41 measured by the maximum residence-time test section 708 are used, in case the allocation sequence of the time slot to each wireless terminals 10-40 is determined. However, before determining allocation sequence, it classifies into the wireless terminal which receives the packet in the wireless terminal which receives the packet in the buffer with which the maximum residence time exceeded predetermined allowed time for each wireless terminals 10-40, and the buffer with which the maximum residence time does not exceed predetermined allowed time in the classification processing section 710 by the maximum residence time.

[0061] Allocation sequence is the following, and is made and determined. In the slot allocation sequence decision processing section 712 About the wireless terminal which receives the packet in the buffer with which the maximum residence time exceeded predetermined allowed time Descending of the maximum residence time of the buffer which corresponds the allocation sequence of a time slot, It is decided that they will be descending of the corresponding number of modulation multiple values and order with little amount of data of a corresponding buffer. then, about the wireless terminal which receives the packet in the buffer with which the maximum residence time does not exceed predetermined allowed time The allocation sequence of a time slot is determined as descending of the corresponding number of modulation multiple values, order with little amount of data of a corresponding buffer, and descending of the maximum residence time of the packet in a corresponding buffer.

[0062] Thus, after the allocation sequence of a time slot is determined to all the wireless terminals 10-40, in the slot allocation processing section 714, processing which assigns a time slot to each wireless terminals 10-40 according to this allocation sequence is performed, and the packet stored in buffers 11-41 is transmitted to each wireless terminals 10-40 in the transmitting section 716 using the assigned time slot.

[0063] On the other hand, in case drawing 8 transmits a packet to a base transceiver station 1 from each wireless terminals 10-40, it is the block diagram of the processing which determines that the number of modulation multiple values will satisfy the communication link quality demanded, and assigns a communication line to each wireless terminals 10-40.

[0064] Each wireless terminals 10-40 have transmitted the predetermined signal to the base transceiver station 1 in the transmitting section 801. Moreover, in the amount-of-data test

section 806, the amount of data of the buffers 12-42 to build in is measured, and it transmits to a base transceiver station 1. In the maximum residence-time test section 808, the residence time (the maximum residence time) of the packet which is piling up for a long time in the buffer 12-42 to build in is measured, and it transmits to a base transceiver station 1.
[0065] A base transceiver station 1 measures an SN ratio for every wireless terminal in the SN ratio test section 804 about the signal received from each wireless terminals 10-40. Moreover, in the number decision section 805 of multiple values, in these receiving SN ratio, in not judging and satisfying whether the communication link quality demanded can be satisfied, it performs processing which lowers the number of modulation multiple values.
[0066] In the slot allocation priority foreword decision processing section 812, the maximum residence time of the packet in the buffer 12-42 sent from the number of modulation multiple values for every wireless terminal 10-40 determined by the number decision section 805 of multiple values and each wireless terminals 10-40 and three parameters of the amount of data are used, in case the allocation sequence of the time slot to each wireless terminals 10-40 is determined. However, before determining allocation sequence, it classifies into the wireless terminal which receives the packet in the wireless terminal which receives the packet in the buffer with which the maximum residence time exceeded predetermined allowed time for each wireless terminals 10-40, and the buffer with which the maximum residence time does not exceed predetermined allowed time in the classification processing section 810 by the maximum residence time.
[0067] Allocation sequence is the following, and is made and determined. In the slot allocation sequence decision processing section 812 About the wireless terminal which receives the packet in the buffer with which the maximum residence time exceeded predetermined allowed time like the slot allocation sequence decision processing section 712 shown in drawing 7 Descending of the maximum residence time of the buffer which corresponds the allocation sequence of a time slot, It is decided that they will be descending of the corresponding number of modulation multiple values and order with little amount of data of a corresponding buffer. then, about the wireless terminal which receives the packet in the buffer with which the maximum residence time does not exceed predetermined allowed time The allocation sequence of a time slot is determined as descending of the corresponding number of modulation multiple values, order with little amount of data of a corresponding buffer, and descending of the maximum residence time of the packet in a corresponding buffer.
[0068] Thus, after the allocation sequence of a time slot is determined to all the wireless terminals 10-40, in the slot allocation processing section 814, processing which assigns a time slot to each wireless terminals 10-40 according to this allocation sequence is performed. Each wireless terminals 10-40 transmit the packet stored in the buffers 12-42 to build in to a base transceiver station 1 using the assigned time slot.
[0069] The flow chart of priority foreword decision processing of the slot allocation in the operation gestalt of drawing 7 and drawing 8 which were mentioned above is shown in drawing 9 .

[0070] When not satisfying the receiving quality as which a receiving SN ratio is required after acquiring three parameters of the amount of data in a receiving SN ratio and a buffer, and the maximum residence time, even the processing classified into the wireless terminal with which the number of modulation multiple values of a corresponding wireless terminal was lowered, and the maximum residence time exceeded allowed time, and the wireless terminal with which the maximum residence time does not exceed allowed time is the 1st step. Then, in the 2nd step, the amount of data in the number of modulation multiple values and a buffer and allocation processing of a time slot based on three parameters of the maximum residence time are performed.
[0071] Processing which will assign a time slot with the priority to the wireless terminal if the wireless terminal with which the maximum residence time exceeded allowed time exists so that clearly from drawing 9 is performed, and after that, if an empty slot still exists, processing which assigns a time slot to the wireless terminal with which the maximum residence time does not exceed allowed time will be performed. The flow of detailed processing of the wireless terminal

with which the maximum residence time of a packet exceeded allowed time, and each wireless terminal which has not exceeded is shown in drawing 11 and drawing 12 . It is necessary to each wireless terminals 10-40 to grasp a base transceiver station 1 for every period which performs quality control for the amount of data accumulated into the maximum residence time of the packet in a buffer, and the present buffer. In addition, although it is with the case where it does not exceed with the case where the maximum residence time of a packet exceeds allowed time and the allocation sequence of the time slot in the 2nd step differs, the 1st-step processing in which a wireless terminal is classified in consideration of the maximum residence time of a packet in the case of which is the same.
[0072] Moreover, with this operation gestalt, processing which determines the number of modulation multiple values with the receiving SN ratio acquired for every fixed period, and processing which assigns, the processing, i.e., the time slot, which determines the allocation sequence of a time slot, can be performed independently. For example, in an intense environment, fluctuation of an input signal can acquire a receiving SN ratio, and can make [many] the frequency where the number of modulation multiple values is determined. On the other hand, the frequency where the allocation sequence of a time slot is determined can be decided according to the speed of fluctuation of traffic. In this case, the number of modulation multiple values in the time of performing allocation processing is used for the information on the number of modulation multiple values required in case a time slot is assigned.
[0073] However, when the period of the processing which determines the number of modulation multiple values, and the period of the processing which assigns a time slot are in agreement, the use effectiveness of a communication line can be raised. Therefore, the case where are the same period and processing which determines the number of modulation multiple values here, and processing which assigns a time slot are performed is explained.
[0074] The 1st-step processing in the operation gestalt of introduction drawing 9 is explained. When the number decision sections 705 and 805 of multiple values have not satisfied the necessary value which judges whether the receiving SN ratio has satisfied the necessary value (step 901) paying attention to the acquired receiving SN ratio, the number decision sections 705 and 805 of multiple values perform processing which lowers the number of modulation multiple values of a corresponding wireless terminal (step 902).
[0075] In the last number decision processing of multiple values, the maximum usable number of modulation multiple values is determined, and the wireless terminal under connection is used, in order to make [many] the amount of information which can be transmitted at once and to raise the use effectiveness of a communication line. That is, the power of an input signal, and a noise and interference power are measured, and it asks for a receiving SN ratio. And in this receiving SN ratio, the maximum number of modulation multiple values which can fulfill the bit error rate which is one of the receiving quality demanded, and a packet error rate is determined, and it is used for subsequent communication links.
[0076] However, in the electric-wave environment of radio, it becomes weak and a bit error rate and a packet error rate increase to a noise or interference, so that the receiving SN ratio is always changed also during a communication link and the number of modulation multiple values becomes large. Therefore, by lowering the number of modulation multiple values, since it becomes impossible to satisfy a bit error rate etc. when a receiving SN ratio is less than a necessary value with fluctuation of an input signal, increase of interference power, etc. if it remains as it is, even if it sacrifices use effectiveness of a communication line, communication link quality is maintained.
[0077] An example is given and explained to drawing 10 about the processing which lowers the number of modulation multiple values. The graph of this drawing expresses relation with the communication link quality (bit error rate: BER) in various modulation multiple values of several n required as a receiving SN ratio. It can be satisfied with the receiving SN ratio at the time of determining the number of modulation multiple values last time of the bit error rate demanded even if it uses which number of modulation multiple values of n=4-256 mentioned here with the example shown in drawing 10 . However, that a communication line should be used efficiently, since it is necessary to use as large the number of modulation multiple values as possible, it is

referred to as n= 256 and asks for the necessary receiving SN ratio in n= 256.
[0078] When the present receiving SN ratio is less than the necessary receiving SN ratio in n= 256 with fluctuation of a subsequent input signal, increase of interference power, etc., it becomes impossible and to satisfy the bit error rate demanded. Then, it lowers to n= 64 which is the maximum number of modulation multiple values with which are satisfied of the bit error rate of which n= 256 modulation multiple values are required in a current receiving SN ratio. Whenever it furthermore asks for the necessary receiving SN ratio in n= 64 and decision processing of the subsequent numbers of modulation multiple values is performed, the comparison with the receiving SN ratio in the time is performed.
[0079] Here, the relation between a receiving SN ratio and a bit error rate can use the theoretical value nearest to the electric-wave environment of a system. Moreover, the base transceiver station which determines the number of modulation multiple values is beforehand equipped with the information about the property of such a radio-wave-propagation way as a table, and you may make it refer to at the time of the number decision of modulation multiple values.
[0080] In addition, when the minimum number of modulation multiple values beforehand defined in the system is being used, it does not carry out lowering the number of modulation multiple values more than it, but it performs the next processing.
[0081] It returns and explains to drawing 9 again. As mentioned above, after the number of modulation multiple values is determined based on a receiving SN ratio, the classification processing sections 710 and 810 by the maximum residence time judge whether the maximum residence time is over allowed time among three parameters of the amount of data in the number of modulation multiple values, and a buffer, and the maximum residence time (step 903), and classify it into the wireless terminal with which the maximum residence time exceeded allowed time, and the wireless terminal which has not exceeded (steps 904 and 905).
[0082] Then, the 2nd-step processing is explained. First, processing to the wireless terminal with which the maximum residence time exceeded allowed time is performed (step 906). The detail of the processing to these wireless terminals is shown in drawing 11 .
[0083] The slot allocation priority foreword decision processing sections 712 and 812 sort each wireless terminal to descending of the maximum residence time so that they may assign a time slot with the priority to the large wireless terminal of the maximum residence time so that the time delay of a wireless terminal may not be increased (step 1101). This sorted sequence turns into allocation sequence of a time slot.
[0084] However, since two or more wireless terminals in which the maximum residence time has the same value may exist, when it judges whether two or more wireless terminals in which the maximum residence time has the same value exist (step 1102) and exists [two or more] it, about these wireless terminals, the slot allocation priority foreword decision processing sections 712 and 812 sort to descending of the number of modulation multiple values (step 1103), and determine the allocation sequence of a time slot.
[0085] Since two or more wireless terminals which have the same value also about the number of modulation multiple values may exist here, the slot allocation priority foreword decision processing sections 712 and 812 When it judges whether two or more wireless terminals in which the number of modulation multiple values furthermore has the same value exist (step 1104) and more than one exist it, about these wireless terminals, it sorts in order with little amount of data in a buffer (step 1105), and the allocation sequence of a time slot is determined.
[0086] Thus, if it judges whether the slot allocation processing sections 714 and 814 have an empty slot (step 1106) and there is an empty slot about all the wireless terminals with which the maximum residence time exceeded allowed time after the allocation sequence of a time slot is determined uniquely, processing which assigns the empty slot to a wireless terminal will be performed (step 1107). Judgment processing (step 1106) of whether there are these empty slots and allocation processing (step 1107) of a time slot are repeated until it assigns a time slot to all the wireless terminals with which the maximum residence time exceeded allowed time or an empty slot is lost.
[0087] Again, it returns and explains to drawing 9 . If it is judged after termination of the

processing (step 906) to the wireless terminal with which the maximum residence time exceeded allowed time whether there is still any empty slot (step 907) and there is an empty slot, processing (step 908) to the wireless terminal with which the maximum residence time does not exceed allowed time will be performed. The detail of the processing to these wireless terminals is shown in drawing 12 .
[0088] The slot allocation priority foreword decision processing sections 712 and 812 sort each wireless terminal to descending of the number of modulation multiple values so that the number of modulation multiple values may assign a time slot preferentially to a large wireless terminal (step 1201). This sorted sequence turns into allocation sequence of a time slot.
[0089] Since two or more wireless terminals in which the number of modulation multiple values has the same value may exist, however, the slot allocation priority foreword decision processing sections 712 and 812 When it judges whether two or more wireless terminals in which the number of modulation multiple values has the same value exist (step 1202) and more than one exist it, about these wireless terminals, it sorts in order with little amount of data in a buffer (step 1203), and the allocation sequence of a time slot is determined.
[0090] Since two or more wireless terminals which have the same value also about the amount of data in a buffer may exist here, the slot allocation priority foreword decision processing sections 712 and 812 When it judges (step 1204) and more than one exist, whether two or more wireless terminals with a value with the still more nearly same amount of data in a buffer exist About these wireless terminals, it sorts to descending of the maximum residence time (step 1205), and the allocation sequence of a time slot is determined.
[0091] Thus, if it judges whether the slot allocation processing sections 714 and 814 have an empty slot (step 1206) and there is an empty slot about all the wireless terminals with which the maximum residence time does not exceed allowed time after the allocation sequence of a time slot is determined uniquely, processing which assigns the empty slot to a wireless terminal will be performed (step 1207). Judgment processing (step 1206) of whether there are these empty slots and allocation processing (step 1207) of a time slot are repeated until it assigns a time slot to all the wireless terminals with which the maximum residence time does not exceed allowed time or an empty slot is lost.
[0092] Here, the decision approach of the number of slots at the time of assigning a time slot to each wireless terminal is explained. Drawing 13 is drawing showing the time-slot configuration of a Time Division Multiple Access method. The information about the amount of data in a buffer is sent according to the sequence for control (CS). Here, the amount of data in a buffer is set to D (bits).
[0093] About the number of modulation multiple values, if the information on N (bits) shall be sent as n and one symbol, it will become the relation it is unrelated N=log2n. If the number of symbols (decided by the band of a system) which can be transmitted by one slot is set to S (symbols), the number of bits which can be transmitted by one slot will serve as SN (bits).
[0094] Therefore, the number of slots which should be assigned in order to transmit D (bits) in a buffer becomes D/(SN) =D/(Slog2n). That is, there are few slots to assign, it ends and can use a communication line efficiently, so that the modulation multiple value of several n is large. In a base transceiver station 1, processing which assigns the empty slot for several required time-slot minutes is performed to each wireless terminal according to the determined allocation sequence.
[0095] Next, how to find the maximum residence time of the packet in a buffer is explained. The packet transmitted to the buffer in the base transceiver station which is a transmitting side in case a packet is transmitted to each wireless terminal from a base transceiver station is stored, and on the other hand, in case a packet is transmitted to a base transceiver station from each wireless terminal, the packet transmitted to the buffer within each wireless terminal which is a transmitting side is stored. These buffers are equivalent to the queue of FIFO (First-In First-Out). The generating time of day of a packet is described by the header unit of each packet stored.
[0096] Since the newly generated packet is placed at the tail end of a buffer in good order, the residence time (elapsed time after a packet occurs) of the packet in the front row, i.e., the

packet which should be sent out next from a buffer, will become the longest in the residence time of all the packets in a buffer. Therefore, the residence time of the packet in the front row of a buffer can be defined as the maximum residence time. In case a packet is transmitted to a base transceiver station from each wireless terminal, each wireless terminal needs to notify this maximum residence time to a base transceiver station 1.

[0097] Then, the flow from connection initiation with a base transceiver station and a wireless terminal to termination is explained using drawing 14 and drawing 15 .

[0098] A base transceiver station is an example in case, as for drawing 14 , a transmitting side and a wireless terminal serve as a receiving side. First, in case connection is started, a transmitting side transmits the control signal for a connection request to a receiving side. While a receiving side answers this connection request, when requiring predetermined communication link quality, it notifies to coincidence also about that communication link quality ("demand quality" is called below) to demand. What is necessary is for demand quality to be the allowed time of a necessary bit error rate (BER) and the maximum residence time of a packet, and to notify to a transmitting side here only in the case of the first connection, when a receiving side requires these.

[0099] When the response to a connection request comes on the contrary from a receiving side, a transmitting side requires the parameter for determining the allocation sequence of a time slot. A receiving side notifies a receiving SN ratio as a parameter according to this demand.

[0100] By the approach shown in drawing 4 or drawing 9 based on the amount of data in this notified receiving SN ratio and the buffer in that time, and the maximum residence time of the packet in a buffer, a transmitting side determines that allocation sequence and assigns a time slot to each wireless terminal while it determines the number of time slots assigned to every wireless terminal. Moreover, by the approach shown in drawing 10 , in making the number of modulation multiple values adjustable, a receiving side determines the necessary receiving SN ratio in the number of modulation multiple values while determining the number of modulation multiple values.

[0101] A transmitting side notifies the assigned time slot and the changed number of modulation multiple values to a receiving side. And when the response to these has come back from the receiving side, a transmitting side starts transmission of the packet stored in the buffer.

[0102] A receiving side will notify the receiving SN ratio in the time as a parameter, if a packet is received. A transmitting side determines the allocation sequence at the time of assigning a time slot to each wireless terminal again based on the amount of data in this notified receiving SN ratio and the buffer in that time, and the maximum residence time of the packet in a buffer. Thus, the allocation sequence at the time of assigning a time slot to each wireless terminal is updated for every frame, and it is repeated until connection is completed.

[0103] In addition, the processing which determines the allocation sequence of the processing and the time slot which determine the number of modulation multiple values from a receiving SN ratio may not be the same period as mentioned above. Moreover, it is also possible for it not to be necessary to necessarily process these processings for every frame, and to process per several frames. What is necessary is to think that a system characteristic becomes good so that the period of processing is short, but just to decide spacing of the processing optimal in the case of a system design, since processing becomes complicated. However, in order for the signal from all the wireless terminals covered in a base transceiver station to arrive, since the time amount for one frame is required, also at the lowest, the period for one frame is required.

[0104] On the other hand, drawing 15 is an example in case a wireless terminal serves as a transmitting side and a base transceiver station serves as a receiving side. First, in case connection is started, a transmitting side transmits the control signal for a connection request to a receiving side. When a transmitting side requires predetermined communication link quality, it notifies to a receiving side also about the demand quality.

[0105] When the response to a connection request comes on the contrary from a receiving side, a transmitting side notifies the parameter for determining the allocation sequence of a time slot. The parameter notified here is the maximum residence time of the amount of data in the buffer in the time, or the packet in a buffer. By the approach shown in drawing 4 or drawing 9 based on

the parameter and receiving SN ratio which were these-notified, a receiving side determines the allocation sequence and assigns a time slot to each wireless terminal while it determines the number of time slots assigned to every wireless terminal. Moreover, by the approach shown in drawing 10 , in making the number of modulation multiple values adjustable, a receiving side determines the necessary receiving SN ratio in the number of modulation multiple values while determining the number of modulation multiple values.
[0106] If the time slot assigned from the receiving side and the changed number of modulation multiple values are notified, a transmitting side will start transmission of the packet stored in the buffer. A transmitting side also notifies the maximum residence time of the amount of data in a buffer, or the packet in a buffer collectively in that case. A receiving side determines the allocation sequence at the time of assigning a time slot to each wireless terminal based on the parameter and receiving SN ratio which were these-notified again. Thus, the allocation sequence at the time of assigning a time slot to each wireless terminal is updated for every frame, and it is repeated until connection is completed.
[0107] In addition, with the operation gestalt which shows the communication line allocation approach and which was mentioned above, although allocation sequence was determined based on three parameters, a receiving SN ratio, the amount of data, and the maximum residence time of a packet, based on two parameters of the amount of data, allocation sequence may be determined as a receiving SN ratio, and allocation sequence may be determined based on two parameters of the maximum residence time of a receiving SN ratio and a packet.
[0108] Moreover, although the operation gestalt which shows the communication line allocation approach and which was mentioned above explained the case where the time slot in a Time Division Multiple Access method was assigned, the frequency band in a Frequency-Division-Multiplexing access method, the diffusion code in Code Division Multiple Access, etc. can also be assigned similarly.
[Effect of the Invention] Like ****, the communication link quality control in the invention in this application can suppress and combine not only communication link quality but the residence time of each wireless terminal below with a fixed value, can also raise a throughput, and can offer a good radio communications system.
[0109] Moreover, since the quality of a radio circuit is observed for every frame and a time slot is assigned from the good thing of communication link quality, a throughput becomes good by being able to make sufficiently small the probability which resends a packet, and using the large number of modulation multiple values, and frequency use effectiveness also becomes good. Moreover, a not good thing also lowers the number of modulation multiple values, and the communication link of quality is attained by controlling not to exceed a certain fixed bit error rate. Therefore, even if it sees the system which performs quality control by the invention in this application from the side which employs a system even if it sees from the side which uses a wireless terminal, it is a very good system.
[0110] Furthermore, the wireless terminal of many in granting priority to what has the few amount of data becomes connectable with coincidence. Since the terminal with many amounts of transmit data has many needed time slots, the residence time surely becomes large, but if default value with the residence time is exceeded, since a time slot will be assigned with the priority to these wireless terminals, the residence time of these wireless terminals is not emitted greatly, either.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to a communication device and the communication line allocation approach.

[Translation done.]

PRIOR ART

[Description of the Prior Art] In the radio communications system whose service with voice was a subject, the demand to the so-called multimedia service of the data communication of not only voice but a non-voice, download of a dynamic image and a static image, etc. has been increasing in recent years. For this reason, offer of multimedia service is indispensable to a future radio communications system.
[0003] When realizing such multimedia service, since a communication link far more nearly high-speed than the case of an audio communication link is required, the design of the system which performs efficient transmission which used the communication line effectively is called for. For that purpose, it becomes important by controlling communication link quality to aim at a deployment of a resource.
[0004] The approach based on the amount of data by which the communications control for aiming at such efficient transmission conventionally was stored in the buffer, and the time delay permitted, or the approach based on the signal-to-noise power ratio (SN ratio) of an input signal was adopted. These examples are shown in drawing 16 and 17.
[0005] Drawing 16 is the amount of data stored in the buffer, and a flow chart which shows the communication line allocation approach based on the time delay permitted. In a Time Division Multiple Access, the communication line (channel) assigned to each communication terminal is called a time slot.
[0006] It judges whether the base transceiver station exceeded the time amount (an "allowed value" is called below) by which the elapsed time (a "time delay" is called below) after a packet is stored in each buffer is supervised, and this time delay is permitted (step 1501).
[0007] When the packet to which the time delay is over the allowed value exists, a base transceiver station assigns a time slot to descending of a time delay to each wireless terminal which receives the packet beyond the allowed value (step 1502). Next, a base transceiver station assigns a time slot to order with little amount of data in a buffer to the wireless terminal which receives the packet to which the time delay is not over the allowed value (step 1503).
[0008] Moreover, when the time delay of the packet in all buffers is not over the allowed value, a base transceiver station assigns a time slot to order with little amount of data in a corresponding buffer to each wireless terminal (step 1503). (when negative judgment is carried out at step 1501) In addition, in step 1503, it is because the number of time slots of assign [order with little amount of data in a buffer / a time slot] occupied if there is little amount of data also decreases, so the increment in the number of wireless terminals connectable with coincidence can be expected.
[0009] Thus, by assigning a time slot preferentially to the wireless terminal which receives the packet to which the time delay exceeded the allowed value, it can prevent that a time delay increases and efficient transmission can be performed.
[0010] On the other hand, drawing 17 is a flow chart which shows the communication line allocation approach based on the SN ratio of an input signal. A base transceiver station always observes the receiving SN ratio sent from each wireless terminal (step 1601), and assigns a time slot sequentially from a wireless terminal with this high receiving SN ratio (step 1602).
[0011] Thus, when possibility that a bit error, a packet error, etc. after receiving since

communication link quality has deteriorated will arise is high, as a receiving error is not started if possible, efficient transmission can be performed by making low the priority of assignment of the time slot to a corresponding wireless terminal.

[Translation done.]

* NOTICES *

EFFECT OF THE INVENTION

[Effect of the Invention] Like ****, the communication link quality control in the invention in this application can suppress and combine not only communication link quality but the residence time of each wireless terminal below with a fixed value, can also raise a throughput, and can offer a good radio communications system.
[0109] Moreover, since the quality of a radio circuit is observed for every frame and a time slot is assigned from the good thing of communication link quality, a throughput becomes good by being able to make sufficiently small the probability which resends a packet, and using the large number of modulation multiple values, and frequency use effectiveness also becomes good. Moreover, a not good thing also lowers the number of modulation multiple values, and the communication link of quality is attained by controlling not to exceed a certain fixed bit error rate. Therefore, even if it sees the system which performs quality control by the invention in this application from the side which employs a system even if it sees from the side which uses a wireless terminal, it is a very good system.
[0110] Furthermore, the wireless terminal of many in granting priority to what has the few amount of data becomes connectable with coincidence. Since the terminal with many amounts of transmit data has many needed time slots, the residence time surely becomes large, but if default value with the residence time is exceeded, since a time slot will be assigned with the priority to these wireless terminals, the residence time of these wireless terminals is not emitted greatly, either.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, by the amount of data stored in the buffer shown in drawing 16 , and the communication line allocation approach based on a time delay, since communication link quality is not taken into consideration, the following problems arise.
[0013] For example, communication link quality deteriorates for sharp fluctuation of radio-wave-propagation ways, such as shadowing, and considering the case where a packet error occurs in a receiving side, a time slot is again assigned by the approach shown in drawing 16 that the packet which that error produced should be resent in this case. However, by degradation of communication link quality, even if it assigns a time slot again, a packet error arises again. Consequently, the amount of data which can be transmitted and received correctly, i.e., a throughput, will fall to per unit time amount, and the transmission efficiency in the whole system will fall.
[0014] On the other hand, by the communication line allocation approach based on the SN ratio of an input signal shown in drawing 17 , since the time delay is not taken into consideration, even if the demand to delay is severe, priority is not given to assignment of a time slot to the wireless terminal in the condition that communication link quality has deteriorated. For this reason, although the demand to delay is a severe wireless terminal, even if it connects, the situation of being as being cut on the way **** [, and] arises, and the problem that delay increases arises. [that connection with a base transceiver station cannot be performed]
[0015] This invention being made in view of the problem mentioned above, and aiming at a deployment of a communication line, it is held down to below the value of a request of a time delay, and aims at improving a throughput.

[Translation done.]

MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the communication device of this invention The amount of data [in / it communicates with two or more wireless terminals so that it may be indicated by claim 1, and / the transmitting side for said every wireless terminal] which should transmit, An allocation sequence decision means to determine the allocation sequence of the communication line between said communication devices and said wireless terminals based on the communication link quality in the receiving side for said every wireless terminal, According to said determined allocation sequence, it has the communication line allocation means which assigns the communication line between said communication devices and said wireless terminals.
[0017] Based on the amount of data in the transmitting side for every wireless terminal which should transmit, by determining the allocation sequence of a communication line, a communication line can be assigned preferentially between the communication devices with little amount of data and wireless terminals which communicate, and the wireless terminal which does not have a problem in the residence time etc. can be increased by making the number of wireless terminals linked to coincidence increase with such a communication device. By combining and determining the allocation sequence of a communication line based on the communication link quality in the receiving side for every wireless terminal, data can be preferentially communicated between the good communication device of communication link quality, and a wireless terminal, and a throughput can be raised by decreasing the retry count of data. In addition, a communication line means the time slot in a Time Division Multiple Access method, the frequency band in a Frequency-Division-Multiplexing access method, the diffusion code in Code Division Multiple Access, etc.
[0018] Moreover, the maximum residence time of the data [in / the communication device of this invention communicates with two or more wireless terminals so that it may be indicated by claim 2, and / the transmitting side for said every wireless terminal] which should be transmitted, An allocation sequence decision means to determine the allocation sequence of the communication line between said communication devices and said wireless terminals based on the communication link quality in the receiving side for said every wireless terminal, According to said determined allocation sequence, it has the communication line allocation means which assigns the communication line between said communication devices and said wireless terminals.

[0019] Based on the maximum residence time of the data in the transmitting side for every wireless terminal which should be transmitted, by determining the allocation sequence of a communication line, the large data of the residence time can be transmitted preferentially and the residence time can be improved in such a communication device. By combining and determining the allocation sequence of a communication line based on the communication link quality in the receiving side for every wireless terminal, data can be preferentially communicated between the good communication device of communication link quality, and a wireless terminal, and a throughput can be raised by decreasing the retry count of data.
[0020] Moreover, invention which invention indicated by claim 3 specified the case where said communication device was a transmitting side, and was indicated by claim 4 specifies the case

where said communication device is a receiving side.
[0021] Moreover, the 1st wireless terminal with which the maximum residence time of the data which should be transmitted, or the data which should be received exceeded predetermined time so that this invention might be indicated by claim 5, It has a wireless terminal classification means to classify into the 2nd wireless terminal with which the maximum residence time of the data which should be transmitted, or the data which should be received does not exceed predetermined time. Said allocation sequence decision means While giving priority over said 2nd wireless terminal and determining the allocation sequence of said communication line to said 1st wireless terminal, about said 1st wireless terminal The allocation sequence of said communication line is determined as descending of the maximum residence time of said data which should be transmitted, or the data which should be received, and the good order of said communication link quality. About said 2nd wireless terminal By determining the allocation sequence of said communication line as descending of the maximum residence time of the good order of said communication link quality, said data which should be transmitted, or the data which should be received Since a communication line is assigned to descending of the maximum residence time about the large thing of the maximum residence time and a communication line is assigned to the good order of communication link quality about the small thing of the maximum residence time, A communication line can be assigned aiming at harmony with an improvement of the residence time and improvement in a throughput.
[0022] Moreover, said allocation sequence decision means determines the allocation sequence of said communication line based on said maximum residence time of the data which should be transmitted and amount of data, and said communication link quality so that this invention may be indicated by claim 6. In this case, a communication line can be assigned preferentially between the communication devices with little amount of data and wireless terminals which communicate, and the wireless terminal which does not have a problem in the residence time etc. can be increased by making the number of wireless terminals linked to coincidence increase.

[0023] The 1st wireless terminal with which the maximum residence time of the data which should be transmitted, or the data which should be received exceeded predetermined time so that it might be especially indicated by claim 7, It has a wireless terminal classification means to classify into the 2nd wireless terminal with which the maximum residence time of the data which should be transmitted, or the data which should be received does not exceed predetermined time. Said allocation sequence decision means While giving priority over said 2nd wireless terminal and determining the allocation sequence of said communication line to said 1st wireless terminal, about said 1st wireless terminal Descending of the maximum residence time of said data which should be transmitted, or the data which should be received, The allocation sequence of said communication line is determined as order with little the good order of said communication link quality, said amount of data which should transmit, or the amount of data which should receive. About said 2nd wireless terminal By determining the allocation sequence of said communication line as descending of the maximum residence time of order with little the good order of said communication link quality, said amount of data which should transmit, or the amount of data which should receive, said data which should be transmitted, or the data which should be received A communication line can be assigned like invention indicated by claim 5, aiming at harmony with an improvement of the residence time and improvement in a throughput, it can combine, and the wireless terminal which does not have a problem in the residence time etc. can be increased by making the number of wireless terminals linked to coincidence increase.

[0024] This invention so that it may be indicated by claim 8 moreover, said allocation sequence decision means Instead of determining the allocation sequence of the communication line between said communication devices and said wireless terminals based on the communication link quality in the receiving side for said every wireless terminal Based on the number of modulation multiple values of the digital modulation method corresponding to the communication link quality in the receiving side for said every wireless terminal, by determining the allocation sequence of the communication line between said communication devices and said wireless

terminals The allocation sequence of a communication line as well as the case where communication link quality is used can be determined using the number of modulation multiple values.
[0025] Moreover, invention indicated by claims 9-16 is the communication line allocation approach of having been suitable for the communication device indicated by claims 1-8.
[0026]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained based on a drawing. Drawing 1 is drawing showing the fundamental configuration of the radio communications system with which the communication device concerning the gestalt of operation of this invention and the communication line allocation approach are applied.
[0027] In the radio communications system shown in this drawing, a communication link is performed between one base transceiver station 1 and each wireless terminals 10, 20, 30, and 40. On the occasion of the communication link between this base transceiver station 1 and each wireless terminals 10-40, control which a base transceiver station 1 assigns the time slot in a Time Division Multiple Access method to each wireless terminals 10-40 is performed.
[0028] The base transceiver station 1 is equipped with the buffers 11, 21, 31, and 41 for several wireless terminal minutes connected. The packet transmitted to the wireless terminal 10 is stored in a buffer 11. Similarly, the packet transmitted to the wireless terminals 20-40 is stored in buffers 21-41. On the other hand, each wireless terminals 10-40 are equipped with the buffers 12, 22, 32, and 42 which store the packet transmitted to a base transceiver station 1.
[0029] In case drawing 2 transmits a packet to each wireless terminals 10-40 from a base transceiver station 1, it is the block diagram of the processing which assigns a time slot to each wireless terminals 10-40.
[0030] In a receive section 202, each wireless terminals 10-40 have received the signal transmitted from a base transceiver station 1, measure the SN ratio (receiving SN ratio) of this input signal in the SN ratio test section 204, and transmit it to a base transceiver station 1. This receiving SN ratio shows the communication link quality of the communication line which transmits data to each wireless terminals 10-40 from a base transceiver station 1.
[0031] A base transceiver station 1 measures the amount of data stored in the buffers 11-41 in a base transceiver station 1 in the amount-of-data test section 206. Moreover, in the maximum residence-time test section 208, the residence time (the "maximum residence time" is called below) of the packet which is piling up for a long time about each of buffers 11-41 is measured.
[0032] In the slot allocation priority foreword decision processing section 212, three parameters of the amount of data of the buffers 11-41 measured by the receiving SN ratio in the wireless terminals 10-40 and the amount-of-data test section 206 and the maximum residence time of the packet in the buffer 11-41 measured by the maximum residence-time test section 208 are used, in case the allocation sequence of the time slot to each wireless terminals 10-40 is determined. However, before determining allocation sequence, it classifies into the wireless terminal which transmits the packet in the wireless terminal which transmits the packet in the buffer with which the maximum residence time exceeded predetermined allowed time for each wireless terminals 10-40, and the buffer with which the maximum residence time does not exceed predetermined allowed time in the classification processing section 210 by the maximum residence time.
[0033] Allocation sequence is the following, and is made and determined. In the slot allocation sequence decision processing section 210 About the wireless terminal which receives the packet in the buffer with which the maximum residence time exceeded predetermined allowed time Descending of the maximum residence time of the buffer which corresponds the allocation sequence of a time slot, It is decided that they will be corresponding descending of a receiving SN ratio and order with little amount of data of a corresponding buffer. then, about the wireless terminal which receives the packet in the buffer with which the maximum residence time does not exceed predetermined allowed time The allocation sequence of a time slot is determined as corresponding descending of a receiving SN ratio, order with little amount of data of a corresponding buffer, and descending of the maximum residence time of the packet in a corresponding buffer.

[0034] Thus, after the allocation sequence of a time slot is determined to all the wireless terminals 10-40, in the slot allocation processing section 314, processing which assigns a time slot to each wireless terminals 10-40 according to this allocation sequence is performed, and the packet stored in buffers 11-41 is transmitted to each wireless terminals 10-40 in the transmitting section 316 using the assigned time slot.
[0035] On the other hand, in case drawing 3 transmits a packet to a base transceiver station 1 from each wireless terminals 10-40, it is the block diagram of the processing which assigns a time slot to each wireless terminals 10-40.
[0036] Each wireless terminals 10-40 have transmitted the predetermined signal to the base transceiver station 1 in the transmitting section 301. Moreover, in the amount-of-data test section 306, the amount of data of the buffers 12-42 to build in is measured, and it transmits to a base transceiver station 1. In the maximum residence-time test section 308, the residence time (the maximum residence time) of the packet which is piling up for a long time in the buffer 12-42 to build in is measured, and it transmits to a base transceiver station 1.
[0037] A base transceiver station 1 measures an SN ratio for every wireless terminal in the SN ratio test section 304 about the signal received from each wireless terminals 10-40. This receiving SN ratio shows the communication link quality of the communication line which transmits data to a base transceiver station 1 from each wireless terminals 10-40.
[0038] In the slot allocation priority foreword decision processing section 312, the maximum residence time of the packet in the buffer 12-42 sent from the receiving SN ratio in the wireless terminals 10-40 measured by the SN ratio test section 304 and each wireless terminals 10-40 and three parameters of the amount of data are used, in case the allocation sequence of the time slot to each wireless terminals 10-40 is determined. However, before determining allocation sequence, it classifies into the wireless terminal which receives the packet in the wireless terminal which receives the packet in the buffer with which the maximum residence time exceeded predetermined allowed time for each wireless terminals 10-40, and the buffer with which the maximum residence time does not exceed predetermined allowed time in the classification processing section 310 by the maximum residence time.
[0039] Allocation sequence is the following, and is made and determined. In the slot allocation sequence decision processing section 312 About the wireless terminal which receives the packet in the buffer with which the maximum residence time exceeded predetermined allowed time like the slot allocation sequence decision processing section 212 shown in drawing 2 Descending of the maximum residence time of the packet in the buffer which corresponds the allocation sequence of a time slot, It is decided that they will be corresponding descending of a receiving SN ratio and order with little amount of data of a corresponding buffer. then, about the wireless terminal which receives the packet in the buffer with which the maximum residence time does not exceed predetermined allowed time The allocation sequence of a time slot is determined as corresponding descending of a receiving SN ratio, order with little amount of data of a corresponding buffer, and descending of the maximum residence time of the packet in a corresponding buffer.
[0040] Thus, if the allocation sequence of a time slot is determined to all the wireless terminals 10-40, in the slot allocation processing section 314, processing which assigns a time slot to each wireless terminals 10-40 according to this allocation sequence will be performed. Each wireless terminals 10-40 transmit the packet stored in the buffers 12-42 to build in to a base transceiver station 1 using the assigned time slot.
[0041] The flow chart of priority foreword decision processing of the slot allocation in the operation gestalt of drawing 2 and drawing 3 which were mentioned above is shown in drawing 4 .

[0042] After acquiring three parameters of the amount of data in a receiving SN ratio and a buffer, and the maximum residence time The wireless terminal which receives or transmits the packet in the buffer with which the maximum residence time exceeded allowed time ("the wireless terminal with which the maximum residence time exceeded allowed time" is called below), Even the processing which classifies the packet in the buffer which has not exceeded into the wireless terminal ("the wireless terminal with which the maximum residence time does

not exceed allowed time" is called below) received or transmitted is the 1st step. Then, in the 2nd step, allocation processing of a time slot based on three parameters of the amount of data in a receiving SN ratio and a buffer and the maximum residence time of a packet is performed.
[0043] Processing which will assign a time slot with the priority to the wireless terminal if the wireless terminal with which the maximum residence time exceeded allowed time exists so that clearly from drawing 4 is performed, and after that, if an empty slot still exists, processing which assigns a time slot to the wireless terminal with which the maximum residence time does not exceed allowed time will be performed. The flow of detailed processing of the wireless terminal with which the maximum residence time of a packet exceeded allowed time, and each wireless terminal which has not exceeded is shown in drawing 5 and drawing 6 . It is necessary to each wireless terminals 10-40 to grasp a base transceiver station 1 for every period which performs quality control for the amount of data accumulated into the maximum residence time of the packet in a buffer, and the present buffer. In addition, although it is with the case where it does not exceed with the case where the maximum residence time of a packet exceeds allowed time and the allocation sequence of the time slot in the 2nd step differs, the 1st-step processing in which a wireless terminal is classified in consideration of the maximum residence time of a packet in the case of which is the same.
[0044] The 1st-step processing in the operation gestalt of introduction drawing 4 is explained. The classification processing sections 210 and 310 by the maximum residence time judge whether the maximum residence time of a packet is over allowed time among three parameters of the amount of data in the acquired receiving SN ratio and a buffer, and the maximum residence time of a packet (step 401), and classify it into the wireless terminal with which the maximum residence time exceeded allowed time, and the wireless terminal which has not exceeded (steps 402 and 403).
[0045] Then, the 2nd-step processing is explained. First, processing to the wireless terminal with which the maximum residence time exceeded allowed time is performed (step 404). The detail of the processing to these wireless terminals is shown in drawing 5 .
[0046] The slot allocation priority foreword decision processing sections 212 and 312 sort each wireless terminal to descending of the maximum residence time so that they may assign a time slot with the priority to the large wireless terminal of the maximum residence time so that the time delay of a wireless terminal may not be increased (step 501). This sorted sequence turns into allocation sequence of a time slot.
[0047] However, two or more wireless terminals in which the maximum residence time has the same value may exist. Then, when it judges whether two or more wireless terminals in which the maximum residence time has the same value exist (step 502) and exists [two or more] it, about these wireless terminals, the slot allocation priority foreword decision processing sections 212 and 312 sort to descending of a receiving SN ratio (step 503), and determine the allocation sequence of a time slot.
[0048] Here, two or more wireless terminals which have the same value also about a receiving SN ratio may exist. Then, when it judges whether two or more wireless terminals in which a receiving SN ratio has the same value further exist (step 504) and exists [two or more] it, about these wireless terminals, the slot allocation priority foreword decision processing sections 212 and 312 sort in order with little amount of data in a buffer (step 505), and determine the allocation sequence of a time slot.
[0049] Thus, if it judges whether the slot allocation processing sections 214 and 314 have an empty slot (step 506) and there is an empty slot about all the wireless terminals with which the maximum residence time exceeded allowed time after the allocation sequence of a time slot is determined uniquely, processing which assigns the empty slot to a wireless terminal will be performed (step 507).
[0050] Judgment processing (step 506) of whether there are these empty slots and allocation processing (step 507) of a time slot are repeated until it assigns a time slot to all the wireless terminals with which the maximum residence time exceeded allowed time or an empty slot is lost. In addition, an empty slot assigns a time slot sequentially from what has the maximum residence time large when there is only no empty slot which transmits all the packets in the

buffer of the transmitting side of a certain thing, and the slot allocation processing sections 214 and 314 end allocation processing (step 507) of a time slot, when an empty slot is lost.

[0051] Again, it returns and explains to drawing 4 . If it is judged after termination of the processing (step 404) to the wireless terminal with which the maximum residence time exceeded allowed time whether there is still any empty slot (step 405) and there is an empty slot, processing (step 406) to the wireless terminal with which the maximum residence time does not exceed allowed time will be performed. The detail of the processing to these wireless terminals is shown in drawing 6 .

[0052] The slot allocation priority foreword decision processing sections 212 and 312 sort each wireless terminal to descending of a receiving SN ratio so that a receiving SN ratio may assign a time slot preferentially to a large wireless terminal (step 601). This sorted sequence turns into allocation sequence of a time slot.

[0053] Since two or more wireless terminals in which a receiving SN ratio has the same value may exist, however, the slot allocation priority foreword decision processing sections 212 and 312 When it judges whether two or more wireless terminals in which a receiving SN ratio has the same value exist (step 602) and more than one exist it, about these wireless terminals, it sorts in order with little amount of data in a buffer (step 603), and the allocation sequence of a time slot is determined.

[0054] Since two or more wireless terminals which have the same value also about the amount of data in a buffer may exist here, the slot allocation priority foreword decision processing sections 212 and 312 When it judges whether two or more wireless terminals with a value with the still more nearly same amount of data in a buffer exist (step 604) and more than one exist it, about these wireless terminals, it sorts to descending of the maximum residence time (step 605), and the allocation sequence of a time slot is determined.

[0055] Thus, if it judges whether the slot allocation processing sections 214 and 314 have an empty slot (step 606) and there is an empty slot about all the wireless terminals with which the maximum residence time does not exceed allowed time after the allocation sequence of a time slot is determined uniquely, processing which assigns the empty slot to a wireless terminal will be performed (step 607). Judgment processing (step 606) of whether there are these empty slots and allocation processing (step 607) of a time slot are repeated until it assigns a time slot to all the wireless terminals with which the maximum residence time does not exceed allowed time or an empty slot is lost.

[0056] As explained to the detail above, based on the maximum residence time of a packet, the large packet of the residence time can be transmitted preferentially and the residence time can be improved. Moreover, based on a receiving SN ratio, a packet can be preferentially communicated between the base transceiver station 1 where this receiving SN ratio is good, and a wireless terminal, and a throughput can be raised by decreasing the retry count of a packet. Furthermore, based on the amount of data in a buffer, a communication line can be assigned preferentially between the base transceiver station 1 with little amount of data with little amount of data which communicates, and a wireless terminal, and the wireless terminal which does not have a problem in the residence time can be increased by making the number of wireless terminals linked to coincidence increase.

[0057] By the way, based on the number of modulation multiple values, the allocation sequence of a time slot can also be determined instead of a receiving SN ratio. In case drawing 7 transmits a packet to each wireless terminals 10-40 from a base transceiver station 1, it is the block diagram of the processing which determines that the number of modulation multiple values will satisfy the communication link quality demanded, and assigns a time slot to each wireless terminals 10-40.

[0058] In a receive section 702, each wireless terminals 10-40 receive the signal transmitted from a base transceiver station 1 like the receive section 202 which showed drawing 2 , measure the SN ratio (receiving SN ratio) of this input signal in the SN ratio test section 704, and transmit it to a base transceiver station 1.

[0059] In the number decision section 705 of multiple values, in the receiving SN ratio sent from each wireless terminals 10-40, a base transceiver station 1 performs processing which lowers

the number of modulation multiple values, when not judging and satisfying whether the communication link quality (for example, a bit error rate and a packet error rate) demanded can be satisfied.

[0060] The number of modulation multiple values for every wireless terminal 10-40 determined by the number decision section 705 of multiple values, The amount of data of the buffers 11-41 measured by the amount-of-data test section 706, In the slot allocation priority foreword decision processing section 712, three parameters of the maximum residence time of the packet in the buffer 11-41 measured by the maximum residence-time test section 708 are used, in case the allocation sequence of the time slot to each wireless terminals 10-40 is determined. However, before determining allocation sequence, it classifies into the wireless terminal which receives the packet in the wireless terminal which receives the packet in the buffer with which the maximum residence time exceeded predetermined allowed time for each wireless terminals 10-40, and the buffer with which the maximum residence time does not exceed predetermined allowed time in the classification processing section 710 by the maximum residence time.

[0061] Allocation sequence is the following, and is made and determined. In the slot allocation sequence decision processing section 712 About the wireless terminal which receives the packet in the buffer with which the maximum residence time exceeded predetermined allowed time Descending of the maximum residence time of the buffer which corresponds the allocation sequence of a time slot, It is decided that they will be descending of the corresponding number of modulation multiple values and order with little amount of data of a corresponding buffer. then, about the wireless terminal which receives the packet in the buffer with which the maximum residence time does not exceed predetermined allowed time The allocation sequence of a time slot is determined as descending of the corresponding number of modulation multiple values, order with little amount of data of a corresponding buffer, and descending of the maximum residence time of the packet in a corresponding buffer.

[0062] Thus, after the allocation sequence of a time slot is determined to all the wireless terminals 10-40, in the slot allocation processing section 714, processing which assigns a time slot to each wireless terminals 10-40 according to this allocation sequence is performed, and the packet stored in buffers 11-41 is transmitted to each wireless terminals 10-40 in the transmitting section 716 using the assigned time slot.

[0063] On the other hand, in case drawing 8 transmits a packet to a base transceiver station 1 from each wireless terminals 10-40, it is the block diagram of the processing which determines that the number of modulation multiple values will satisfy the communication link quality demanded, and assigns a communication line to each wireless terminals 10-40.

[0064] Each wireless terminals 10-40 have transmitted the predetermined signal to the base transceiver station 1 in the transmitting section 801. Moreover, in the amount-of-data test section 806, the amount of data of the buffers 12-42 to build in is measured, and it transmits to a base transceiver station 1. In the maximum residence-time test section 808, the residence time (the maximum residence time) of the packet which is piling up for a long time in the buffer 12-42 to build in is measured, and it transmits to a base transceiver station 1.

[0065] A base transceiver station 1 measures an SN ratio for every wireless terminal in the SN ratio test section 804 about the signal received from each wireless terminals 10-40. Moreover, in the number decision section 805 of multiple values, in these receiving SN ratio, in not judging and satisfying whether the communication link quality demanded can be satisfied, it performs processing which lowers the number of modulation multiple values.

[0066] In the slot allocation priority foreword decision processing section 812, the maximum residence time of the packet in the buffer 12-42 sent from the number of modulation multiple values for every wireless terminal 10-40 determined by the number decision section 805 of multiple values and each wireless terminals 10-40 and three parameters of the amount of data are used, in case the allocation sequence of the time slot to each wireless terminals 10-40 is determined. However, before determining allocation sequence, it classifies into the wireless terminal which receives the packet in the wireless terminal which receives the packet in the buffer with which the maximum residence time exceeded predetermined allowed time for each wireless terminals 10-40, and the buffer with which the maximum residence time does not

exceed predetermined allowed time in the classification processing section 810 by the maximum residence time.
[0067] Allocation sequence is the following, and is made and determined. In the slot allocation sequence decision processing section 812 About the wireless terminal which receives the packet in the buffer with which the maximum residence time exceeded predetermined allowed time like the slot allocation sequence decision processing section 712 shown in drawing 7 Descending of the maximum residence time of the buffer which corresponds the allocation sequence of a time slot, It is decided that they will be descending of the corresponding number of modulation multiple values and order with little amount of data of a corresponding buffer. then, about the wireless terminal which receives the packet in the buffer with which the maximum residence time does not exceed predetermined allowed time The allocation sequence of a time slot is determined as descending of the corresponding number of modulation multiple values, order with little amount of data of a corresponding buffer, and descending of the maximum residence time of the packet in a corresponding buffer.
[0068] Thus, after the allocation sequence of a time slot is determined to all the wireless terminals 10-40, in the slot allocation processing section 814, processing which assigns a time slot to each wireless terminals 10-40 according to this allocation sequence is performed. Each wireless terminals 10-40 transmit the packet stored in the buffers 12-42 to build in to a base transceiver station 1 using the assigned time slot.
[0069] The flow chart of priority foreword decision processing of the slot allocation in the operation gestalt of drawing 7 and drawing 8 which were mentioned above is shown in drawing 9 .

[0070] When not satisfying the receiving quality as which a receiving SN ratio is required after acquiring three parameters of the amount of data in a receiving SN ratio and a buffer, and the maximum residence time, even the processing classified into the wireless terminal with which the number of modulation multiple values of a corresponding wireless terminal was lowered, and the maximum residence time exceeded allowed time, and the wireless terminal with which the maximum residence time does not exceed allowed time is the 1st step. Then, in the 2nd step, the amount of data in the number of modulation multiple values and a buffer and allocation processing of a time slot based on three parameters of the maximum residence time are performed.
[0071] Processing which will assign a time slot with the priority to the wireless terminal if the wireless terminal with which the maximum residence time exceeded allowed time exists so that clearly from drawing 9 is performed, and after that, if an empty slot still exists, processing which assigns a time slot to the wireless terminal with which the maximum residence time does not exceed allowed time will be performed. The flow of detailed processing of the wireless terminal with which the maximum residence time of a packet exceeded allowed time, and each wireless terminal which has not exceeded is shown in drawing 11 and drawing 12 . It is necessary to each wireless terminals 10-40 to grasp a base transceiver station 1 for every period which performs quality control for the amount of data accumulated into the maximum residence time of the packet in a buffer, and the present buffer. In addition, although it is with the case where it does not exceed with the case where the maximum residence time of a packet exceeds allowed time and the allocation sequence of the time slot in the 2nd step differs, the 1st-step processing in which a wireless terminal is classified in consideration of the maximum residence time of a packet in the case of which is the same.
[0072] Moreover, with this operation gestalt, processing which determines the number of modulation multiple values with the receiving SN ratio acquired for every fixed period, and processing which assigns, the processing, i.e., the time slot, which determines the allocation sequence of a time slot, can be performed independently. For example, in an intense environment, fluctuation of an input signal can acquire a receiving SN ratio, and can make [many] the frequency where the number of modulation multiple values is determined. On the other hand, the frequency where the allocation sequence of a time slot is determined can be decided according to the speed of fluctuation of traffic. In this case, the number of modulation multiple values in the time of performing allocation processing is used for the information on the

number of modulation multiple values required in case a time slot is assigned.

[0073] However, when the period of the processing which determines the number of modulation multiple values, and the period of the processing which assigns a time slot are in agreement, the use effectiveness of a communication line can be raised. Therefore, the case where are the same period and processing which determines the number of modulation multiple values here, and processing which assigns a time slot are performed is explained.

[0074] The 1st-step processing in the operation gestalt of introduction drawing 9 is explained. When the number decision sections 705 and 805 of multiple values have not satisfied the necessary value which judges whether the receiving SN ratio has satisfied the necessary value (step 901) paying attention to the acquired receiving SN ratio, the number decision sections 705 and 805 of multiple values perform processing which lowers the number of modulation multiple values of a corresponding wireless terminal (step 902).

[0075] In the last number decision processing of multiple values, the maximum usable number of modulation multiple values is determined, and the wireless terminal under connection is used, in order to make [many] the amount of information which can be transmitted at once and to raise the use effectiveness of a communication line. That is, the power of an input signal, and a noise and interference power are measured, and it asks for a receiving SN ratio. And in this receiving SN ratio, the maximum number of modulation multiple values which can fulfill the bit error rate which is one of the receiving quality demanded, and a packet error rate is determined, and it is used for subsequent communication links.

[0076] However, in the electric-wave environment of radio, it becomes weak and a bit error rate and a packet error rate increase to a noise or interference, so that the receiving SN ratio is always changed also during a communication link and the number of modulation multiple values becomes large. Therefore, by lowering the number of modulation multiple values, since it becomes impossible to satisfy a bit error rate etc. when a receiving SN ratio is less than a necessary value with fluctuation of an input signal, increase of interference power, etc. if it remains as it is, even if it sacrifices use effectiveness of a communication line, communication link quality is maintained.

[0077] An example is given and explained to drawing 10 about the processing which lowers the number of modulation multiple values. The graph of this drawing expresses relation with the communication link quality (bit error rate: BER) in various modulation multiple values of several n required as a receiving SN ratio. It can be satisfied with the receiving SN ratio at the time of determining the number of modulation multiple values last time of the bit error rate demanded even if it uses which number of modulation multiple values of n=4-256 mentioned here with the example shown in drawing 10 . However, that a communication line should be used efficiently, since it is necessary to use as large the number of modulation multiple values as possible, it is referred to as n= 256 and asks for the necessary receiving SN ratio in n= 256.

[0078] When the present receiving SN ratio is less than the necessary receiving SN ratio in n= 256 with fluctuation of a subsequent input signal, increase of interference power, etc., it becomes impossible and to satisfy the bit error rate demanded. Then, it lowers to n= 64 which is the maximum number of modulation multiple values with which are satisfied of the bit error rate of which n= 256 modulation multiple values are required in a current receiving SN ratio. Whenever it furthermore asks for the necessary receiving SN ratio in n= 64 and decision processing of the subsequent numbers of modulation multiple values is performed, the comparison with the receiving SN ratio in the time is performed.

[0079] Here, the relation between a receiving SN ratio and a bit error rate can use the theoretical value nearest to the electric-wave environment of a system. Moreover, the base transceiver station which determines the number of modulation multiple values is beforehand equipped with the information about the property of such a radio-wave-propagation way as a table, and you may make it refer to at the time of the number decision of modulation multiple values.

[0080] In addition, when the minimum number of modulation multiple values beforehand defined in the system is being used, it does not carry out lowering the number of modulation multiple values more than it, but it performs the next processing.

[0081] It returns and explains to drawing 9 again. As mentioned above, after the number of modulation multiple values is determined based on a receiving SN ratio, the classification processing sections 710 and 810 by the maximum residence time judge whether the maximum residence time is over allowed time among three parameters of the amount of data in the number of modulation multiple values, and a buffer, and the maximum residence time (step 903), and classify it into the wireless terminal with which the maximum residence time exceeded allowed time, and the wireless terminal which has not exceeded (steps 904 and 905).
[0082] Then, the 2nd-step processing is explained. First, processing to the wireless terminal with which the maximum residence time exceeded allowed time is performed (step 906). The detail of the processing to these wireless terminals is shown in drawing 11 .
[0083] The slot allocation priority foreword decision processing sections 712 and 812 sort each wireless terminal to descending of the maximum residence time so that they may assign a time slot with the priority to the large wireless terminal of the maximum residence time so that the time delay of a wireless terminal may not be increased (step 1101). This sorted sequence turns into allocation sequence of a time slot.
[0084] However, since two or more wireless terminals in which the maximum residence time has the same value may exist, when it judges whether two or more wireless terminals in which the maximum residence time has the same value exist (step 1102) and exists [two or more] it, about these wireless terminals, the slot allocation priority foreword decision processing sections 712 and 812 sort to descending of the number of modulation multiple values (step 1103), and determine the allocation sequence of a time slot.
[0085] Since two or more wireless terminals which have the same value also about the number of modulation multiple values may exist here, the slot allocation priority foreword decision processing sections 712 and 812 When it judges whether two or more wireless terminals in which the number of modulation multiple values furthermore has the same value exist (step 1104) and more than one exist it, about these wireless terminals, it sorts in order with little amount of data in a buffer (step 1105), and the allocation sequence of a time slot is determined.
[0086] Thus, if it judges whether the slot allocation processing sections 714 and 814 have an empty slot (step 1106) and there is an empty slot about all the wireless terminals with which the maximum residence time exceeded allowed time after the allocation sequence of a time slot is determined uniquely, processing which assigns the empty slot to a wireless terminal will be performed (step 1107). Judgment processing (step 1106) of whether there are these empty slots and allocation processing (step 1107) of a time slot are repeated until it assigns a time slot to all the wireless terminals with which the maximum residence time exceeded allowed time or an empty slot is lost.
[0087] Again, it returns and explains to drawing 9 . If it is judged after termination of the processing (step 906) to the wireless terminal with which the maximum residence time exceeded allowed time whether there is still any empty slot (step 907) and there is an empty slot, processing (step 908) to the wireless terminal with which the maximum residence time does not exceed allowed time will be performed. The detail of the processing to these wireless terminals is shown in drawing 12 .
[0088] The slot allocation priority foreword decision processing sections 712 and 812 sort each wireless terminal to descending of the number of modulation multiple values so that the number of modulation multiple values may assign a time slot preferentially to a large wireless terminal (step 1201). This sorted sequence turns into allocation sequence of a time slot.
[0089] Since two or more wireless terminals in which the number of modulation multiple values has the same value may exist, however, the slot allocation priority foreword decision processing sections 712 and 812 When it judges whether two or more wireless terminals in which the number of modulation multiple values has the same value exist (step 1202) and more than one exist it, about these wireless terminals, it sorts in order with little amount of data in a buffer (step 1203), and the allocation sequence of a time slot is determined.
[0090] Since two or more wireless terminals which have the same value also about the amount of data in a buffer may exist here, the slot allocation priority foreword decision processing sections 712 and 812 When it judges (step 1204) and more than one exist, whether two or more

wireless terminals with a value with the still more nearly same amount of data in a buffer exist About these wireless terminals, it sorts to descending of the maximum residence time (step 1205), and the allocation sequence of a time slot is determined.
[0091] Thus, if it judges whether the slot allocation processing sections 714 and 814 have an empty slot (step 1206) and there is an empty slot about all the wireless terminals with which the maximum residence time does not exceed allowed time after the allocation sequence of a time slot is determined uniquely, processing which assigns the empty slot to a wireless terminal will be performed (step 1207). Judgment processing (step 1206) of whether there are these empty slots and allocation processing (step 1207) of a time slot are repeated until it assigns a time slot to all the wireless terminals with which the maximum residence time does not exceed allowed time or an empty slot is lost.
[0092] Here, the decision approach of the number of slots at the time of assigning a time slot to each wireless terminal is explained. Drawing 13 is drawing showing the time-slot configuration of a Time Division Multiple Access method. The information about the amount of data in a buffer is sent according to the sequence for control (CS). Here, the amount of data in a buffer is set to D (bits).
[0093] About the number of modulation multiple values, if the information on N (bits) shall be sent as n and one symbol, it will become the relation it is unrelated N=log2n. If the number of symbols (decided by the band of a system) which can be transmitted by one slot is set to S (symbols), the number of bits which can be transmitted by one slot will serve as SN (bits).
[0094] Therefore, the number of slots which should be assigned in order to transmit D (bits) in a buffer becomes D/(SN) =D/(Slog2n). That is, there are few slots to assign, it ends and can use a communication line efficiently, so that the modulation multiple value of several n is large. In a base transceiver station 1, processing which assigns the empty slot for several required time-slot minutes is performed to each wireless terminal according to the determined allocation sequence.
[0095] Next, how to find the maximum residence time of the packet in a buffer is explained. The packet transmitted to the buffer in the base transceiver station which is a transmitting side in case a packet is transmitted to each wireless terminal from a base transceiver station is stored, and on the other hand, in case a packet is transmitted to a base transceiver station from each wireless terminal, the packet transmitted to the buffer within each wireless terminal which is a transmitting side is stored. These buffers are equivalent to the queue of FIFO (First-In First-Out). The generating time of day of a packet is described by the header unit of each packet stored.
[0096] Since the newly generated packet is placed at the tail end of a buffer in good order, the residence time (elapsed time after a packet occurs) of the packet in the front row, i.e., the packet which should be sent out next from a buffer, will become the longest in the residence time of all the packets in a buffer. Therefore, the residence time of the packet in the front row of a buffer can be defined as the maximum residence time. In case a packet is transmitted to a base transceiver station from each wireless terminal, each wireless terminal needs to notify this maximum residence time to a base transceiver station 1.
[0097] Then, the flow from connection initiation with a base transceiver station and a wireless terminal to termination is explained using drawing 14 and drawing 15 .
[0098] A base transceiver station is an example in case, as for drawing 14 , a transmitting side and a wireless terminal serve as a receiving side. First, in case connection is started, a transmitting side transmits the control signal for a connection request to a receiving side. While a receiving side answers this connection request, when requiring predetermined communication link quality, it notifies to coincidence also about that communication link quality ("demand quality" is called below) to demand. What is necessary is for demand quality to be the allowed time of a necessary bit error rate (BER) and the maximum residence time of a packet, and to notify to a transmitting side here only in the case of the first connection, when a receiving side requires these.
[0099] When the response to a connection request comes on the contrary from a receiving side, a transmitting side requires the parameter for determining the allocation sequence of a time slot.

A receiving side notifies a receiving SN ratio as a parameter according to this demand.
[0100] By the approach shown in drawing 4 or drawing 9 based on the amount of data in this notified receiving SN ratio and the buffer in that time, and the maximum residence time of the packet in a buffer, a transmitting side determines that allocation sequence and assigns a time slot to each wireless terminal while it determines the number of time slots assigned to every wireless terminal. Moreover, by the approach shown in drawing 10 , in making the number of modulation multiple values adjustable, a receiving side determines the necessary receiving SN ratio in the number of modulation multiple values while determining the number of modulation multiple values.
[0101] A transmitting side notifies the assigned time slot and the changed number of modulation multiple values to a receiving side. And when the response to these has come back from the receiving side, a transmitting side starts transmission of the packet stored in the buffer.
[0102] A receiving side will notify the receiving SN ratio in the time as a parameter, if a packet is received. A transmitting side determines the allocation sequence at the time of assigning a time slot to each wireless terminal again based on the amount of data in this notified receiving SN ratio and the buffer in that time, and the maximum residence time of the packet in a buffer. Thus, the allocation sequence at the time of assigning a time slot to each wireless terminal is updated for every frame, and it is repeated until connection is completed.
[0103] In addition, the processing which determines the allocation sequence of the processing and the time slot which determine the number of modulation multiple values from a receiving SN ratio may not be the same period as mentioned above. Moreover, it is also possible for it not to be necessary to necessarily process these processings for every frame, and to process per several frames. What is necessary is to think that a system characteristic becomes good so that the period of processing is short, but just to decide spacing of the processing optimal in the case of a system design, since processing becomes complicated. However, in order for the signal from all the wireless terminals covered in a base transceiver station to arrive, since the time amount for one frame is required, also at the lowest, the period for one frame is required.
[0104] On the other hand, drawing 15 is an example in case a wireless terminal serves as a transmitting side and a base transceiver station serves as a receiving side. First, in case connection is started, a transmitting side transmits the control signal for a connection request to a receiving side. When a transmitting side requires predetermined communication link quality, it notifies to a receiving side also about the demand quality.
[0105] When the response to a connection request comes on the contrary from a receiving side, a transmitting side notifies the parameter for determining the allocation sequence of a time slot. The parameter notified here is the maximum residence time of the amount of data in the buffer in the time, or the packet in a buffer. By the approach shown in drawing 4 or drawing 9 based on the parameter and receiving SN ratio which were these-notified, a receiving side determines the allocation sequence and assigns a time slot to each wireless terminal while it determines the number of time slots assigned to every wireless terminal. Moreover, by the approach shown in drawing 10 , in making the number of modulation multiple values adjustable, a receiving side determines the necessary receiving SN ratio in the number of modulation multiple values while determining the number of modulation multiple values.
[0106] If the time slot assigned from the receiving side and the changed number of modulation multiple values are notified, a transmitting side will start transmission of the packet stored in the buffer. A transmitting side also notifies the maximum residence time of the amount of data in a buffer, or the packet in a buffer collectively in that case. A receiving side determines the allocation sequence at the time of assigning a time slot to each wireless terminal based on the parameter and receiving SN ratio which were these-notified again. Thus, the allocation sequence at the time of assigning a time slot to each wireless terminal is updated for every frame, and it is repeated until connection is completed.
[0107] In addition, with the operation gestalt which shows the communication line allocation approach and which was mentioned above, although allocation sequence was determined based on three parameters, a receiving SN ratio, the amount of data, and the maximum residence time of a packet, based on two parameters of the amount of data, allocation sequence may be

determined as a receiving SN ratio, and allocation sequence may be determined based on two parameters of the maximum residence time of a receiving SN ratio and a packet.

[0108] Moreover, although the operation gestalt which shows the communication line allocation approach and which was mentioned above explained the case where the time slot in a Time Division Multiple Access method was assigned, the frequency band in a Frequency-Division-Multiplexing access method, the diffusion code in Code Division Multiple Access, etc. can also be assigned similarly.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the fundamental configuration of the radio communications system with which the communication device concerning the gestalt of operation of this invention and the communication line allocation approach are applied.
[Drawing 2] In case a packet is transmitted to each wireless terminal from a base transceiver station, it is the block diagram of the processing which assigns a communication line to each wireless terminal.
[Drawing 3] In case a packet is transmitted to a base transceiver station from each wireless terminal, it is the block diagram of the processing which assigns a communication line to each wireless terminal.
[Drawing 4] It is the flow chart of priority foreword decision processing of the slot allocation in drawing 2 and the operation gestalt of drawing 3 .
[Drawing 5] It is the flow chart which shows the detail of the processing to the wireless terminal with which the maximum residence time exceeded allowed time among drawing 4 .
[Drawing 6] It is the flow chart which shows the detail of the processing to the wireless terminal with which the maximum residence time does not exceed allowed time among drawing 4 .
[Drawing 7] In case a packet is transmitted to each wireless terminal from a base transceiver station, it is the block diagram of the processing which determines that the number of modulation multiple values will satisfy the communication link quality demanded, and assigns a communication line to each wireless terminal.
[Drawing 8] In case a packet is transmitted to a base transceiver station from each wireless terminal, it is the block diagram of the processing which determines that the number of modulation multiple values will satisfy the communication link quality demanded, and assigns a communication line to each wireless terminal.
[Drawing 9] It is the flow chart of priority foreword decision processing of the slot allocation in drawing 7 and the operation gestalt of drawing 8 .
[Drawing 10] It is drawing showing relation with the communication link quality in the various numbers of modulation multiple values required as a receiving SN ratio.
[Drawing 11] It is the flow chart which shows the detail of the processing to the wireless terminal with which the maximum residence time exceeded allowed time among drawing 9 .
[Drawing 12] It is the flow chart which shows the detail of the processing to the wireless terminal with which the maximum residence time does not exceed allowed time among drawing 9 .
[Drawing 13] It is drawing showing the time-slot configuration of a Time Division Multiple Access method.
[Drawing 14] A base transceiver station is the sequence diagram in which a transmitting side and a wireless terminal show an example of the flow from the connection initiation in the case of becoming a receiving side to termination.
[Drawing 15] It is the sequence diagram showing an example of the flow from connection initiation in case a wireless terminal serves as a transmitting side and a base transceiver station serves as a receiving side to termination.

[Drawing 16] It is the flow chart of the communication line allocation approach based on the amount of data stored in the conventional buffer, and the time delay permitted.
[Drawing 17] It is the flow chart of the communication line allocation approach based on the conventional receiving SN ratio.
[Description of Notations]
1 Base Transceiver Stations 10, 20, 30, and 40 Wireless Terminal
11, 12, 21, 22, 31, 32, 41, 42 Buffer
202 702 Receive section
204, 304, 704, 804 SN ratio test section
206, 306, 706, 806 Amount-of-data test section
208, 308, 708, 808 The maximum residence-time test section
210, 310, 710, 810 The classification processing section by the maximum residence time
212, 312, 712, 812 Slot allocation priority foreword decision processing section
214, 314, 714, 814 Slot allocation processing section
216, 301, 316, 716, 801, 816 Transmitting section
705 805 The number decision section of multiple values

[Translation done.]

引用文献 3

(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（A）　(11)特許出願公開番号
特開2002－112321
（P2002－112321A）
(43)公開日　平成14年４月12日(2002.4.12)

(51)Int.Cl.7	識別記号	F I		テーマコード゛(参考)
Ｈ０４Ｑ　7/36		Ｈ０４Ｂ　7/26	１０５Ｄ	５Ｋ０３３
Ｈ０４Ｌ　12/28		Ｈ０４Ｌ　11/00	３１０Ｂ	５Ｋ０６７

審査請求　未請求　請求項の数16　ＯＬ　（全 17 頁）

(21)出願番号　特願2000－297186（P2000－297186）
(22)出願日　平成12年９月28日(2000.9.28)

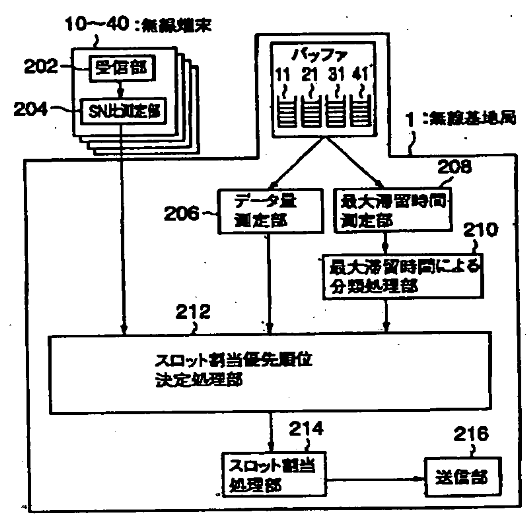
(71)出願人　392026693
株式会社エヌ・ティ・ティ・ドコモ
東京都千代田区永田町二丁目11番１号
(72)発明者　北澤　大介
東京都千代田区永田町二丁目11番１号　株式会社エヌ・ティ・ティ・ドコモ内
(72)発明者　佐藤　嬉珍
東京都千代田区永田町二丁目11番１号　株式会社エヌ・ティ・ティ・ドコモ内
(74)代理人　100070150
弁理士　伊東　忠彦

最終頁に続く

(54)【発明の名称】　通信装置及び通信回線割当方法

(57)【要約】
【課題】　通信回線の有効利用を図りつつ、遅延時間を所望の値以下に抑え、スループットを向上すること。
【解決手段】　各無線端末１０～４０では、受信部２０２は、無線基地局１から送信される信号を受信する。ＳＮ比測定部２０４は、この受信信号のＳＮ比を測定する。無線基地局１では、データ量測定部２０６は、無線基地局１内のバッファ１１～４１に格納されたデータ量を測定する。最大滞留時間測定部２０８は、バッファ１１～４１内のパケットの最大滞留時間を測定する。最大滞留時間による分類処理部２１０は、最大滞留時間に基づいて各無線端末１０～４０を分類する。スロット割当優先順序決定処理部２１２は、受信ＳＮ比、データ量、最大滞留時間、及び最大滞留時間による分類処理部２１０における分類結果に基づいて、各無線端末１０～４０に対するタイムスロットの割当順序を決定する。

無線基地局から各無線端末へパケットを伝送する際に、各無線端末に対し、通信回線を割り当てる処理のブロック図



【特許請求の範囲】
【請求項１】　複数の無線端末と通信を行う通信装置において、
前記各無線端末毎の送信側における送信すべきデータ量と、前記各無線端末毎の受信側における通信品質とに基づいて、前記通信装置と前記無線端末との間の通信回線の割当順序を決定する割当順序決定手段と、
前記決定された割当順序に従って、前記通信装置と前記無線端末との間の通信回線を割り当てる通信回線割当手段と、を備えることを特徴とする通信装置。
【請求項２】　複数の無線端末と通信を行う通信装置において、
前記各無線端末毎の送信側における送信すべきデータの最大滞留時間と、前記各無線端末毎の受信側における通信品質とに基づいて、前記通信装置と前記無線端末との間の通信回線の割当順序を決定する割当順序決定手段と、
前記決定された割当順序に従って、前記通信装置と前記無線端末との間の通信回線を割り当てる通信回線割当手段と、を備えることを特徴とする通信装置。
【請求項３】　請求項２記載の通信装置において、
前記通信装置が送信側である場合、前記割当順序決定手段は、前記通信装置において測定された送信すべきデータの最大滞留時間と、前記各無線端末において測定された通信品質とに基づいて、前記通信回線の割当順序を決定することを特徴とする通信装置。
【請求項４】　請求項２記載の通信装置において、
前記通信装置が受信側である場合、前記割当順序決定手段は、前記通信装置において測定された通信品質と、前記各無線端末において測定された送信すべきデータの最大滞留時間とに基づいて、前記通信回線の割当順序を決定することを特徴とする通信装置。
【請求項５】　請求項２乃至４の何れかに記載の通信装置において、
送信すべきデータ又は受信すべきデータの最大滞留時間が所定時間を超えた第１の無線端末と、送信すべきデータ又は受信すべきデータの最大滞留時間が所定時間を超えない第２の無線端末とに分類する無線端末分類手段を備え、
前記割当順序決定手段は、前記第１の無線端末に対し、前記第２の無線端末に優先して前記通信回線の割当順序を決定するとともに、前記第１の無線端末については、前記送信すべきデータ又は受信すべきデータの最大滞留時間の大きい順、前記通信品質の良好な順に前記通信回線の割当順序を決定し、前記第２の無線端末については、前記通信品質の良好な順、前記送信すべきデータ又は受信すべきデータの最大滞留時間の大きい順に前記通信回線の割当順序を決定することを特徴とする通信装置。
【請求項６】　請求項２記載の通信装置において、
前記割当順序決定手段は、前記送信すべきデータの最大滞留時間及びデータ量と、前記通信品質とに基づいて、前記通信回線の割当順序を決定することを特徴とする通信装置。
【請求項７】　請求項６記載の通信装置において、
送信すべきデータ又は受信すべきデータの最大滞留時間が所定時間を超えた第１の無線端末と、送信すべきデータ又は受信すべきデータの最大滞留時間が所定時間を超えない第２の無線端末とに分類する無線端末分類手段を備え、
前記割当順序決定手段は、前記第１の無線端末に対し、前記第２の無線端末に優先して前記通信回線の割当順序を決定するとともに、前記第１の無線端末については、前記送信すべきデータ又は受信すべきデータの最大滞留時間の大きい順、前記通信品質の良好な順、前記送信すべきデータ量又は受信すべきデータ量の少ない順に前記通信回線の割当順序を決定し、前記第２の無線端末については、前記通信品質の良好な順、前記送信すべきデータ量又は受信すべきデータ量の少ない順、前記送信すべきデータ又は受信すべきデータの最大滞留時間の大きい順に前記通信回線の割当順序を決定することを特徴とする通信装置。
【請求項８】　請求項１乃至７の何れかに記載の通信装置において、
前記割当順序決定手段は、前記各無線端末毎の受信側における通信品質に基づいて、前記通信装置と前記無線端末との間の通信回線の割当順序を決定する代わりに、前記各無線端末毎の受信側における通信品質に対応した、デジタル変調方式の変調多値数に基づいて、前記通信装置と前記無線端末との間の通信回線の割当順序を決定することを特徴とする通信装置。
【請求項９】　複数の無線端末と通信を行う通信装置における通信回線割当方法において、
前記各無線端末毎の送信側における送信すべきデータ量と、前記各無線端末毎の受信側における通信品質とに基づいて、前記通信装置と前記無線端末との間の通信回線の割当順序を決定する手順と、
前記決定された割当順序に従って、前記通信装置と前記無線端末との間の通信回線を割り当てる手順と、を備えることを特徴とする通信回線割当方法。
【請求項１０】　複数の無線端末と通信を行う通信装置における通信回線割当方法において、
前記各無線端末毎の送信側における送信すべきデータの最大滞留時間と、前記各無線端末毎の受信側における通信品質とに基づいて、前記通信装置と前記無線端末との間の通信回線の割当順序を決定する手順と、
前記決定された割当順序に従って、前記通信装置と前記無線端末との間の通信回線を割り当てる手順と、を備えることを特徴とする通信回線割当方法。
【請求項１１】　請求項１０記載の通信回線割当方法に

おいて、
前記通信装置が送信側である場合、前記割当順序を決定する手順は、前記通信装置において測定された送信すべきデータの最大滞留時間と、前記各無線端末において測定された通信品質とに基づいて、前記通信回線の割当順序を決定することを特徴とする通信回線割当方法。

【請求項１２】　請求項１０記載の通信回線割当方法において、
前記通信装置が受信側である場合、前記割当順序を決定する手順は、前記通信装置において測定された通信品質と、前記各無線端末において測定された送信すべきデータの最大滞留時間とに基づいて、前記通信回線の割当順序を決定することを特徴とする通信回線割当方法。

【請求項１３】　請求項１０乃至１２の何れかに記載の通信回線割当方法において、
送信すべきデータ又は受信すべきデータの最大滞留時間が所定時間を超えた第１の無線端末と、送信すべきデータ又は受信すべきデータの最大滞留時間が所定時間を超えない第２の無線端末とに分類する手順を備え、
前記割当順序を決定する手順は、前記第１の無線端末に対し、前記第２の無線端末に優先して前記通信回線の割当順序を決定するとともに、前記第１の無線端末については、前記送信すべきデータ又は受信すべきデータの最大滞留時間の大きい順、前記通信品質の良好な順に前記通信回線の割当順序を決定し、前記第２の無線端末については、前記通信品質の良好な順、前記送信すべきデータ又は受信すべきデータの最大滞留時間の大きい順に前記通信回線の割当順序を決定することを特徴とする通信回線割当方法。

【請求項１４】　請求項１０記載の通信回線割当方法において、
前記割当順序決定する手順は、前記送信すべきデータの最大滞留時間及びデータ量と、前記通信品質とに基づいて、前記通信回線の割当順序を決定することを特徴とする通信回線割当方法。

【請求項１５】　請求項１４記載の通信回線割当方法において、
送信すべきデータ又は受信すべきデータの最大滞留時間が所定時間を超えた第１の無線端末と、送信すべきデータ又は受信すべきデータの最大滞留時間が所定時間を超えない第２の無線端末とに分類する手順を備え、
前記割当順序を決定する手順は、前記第１の無線端末に対し、前記第２の無線端末に優先して前記通信回線の割当順序を決定するとともに、前記第１の無線端末については、前記送信すべきデータ又は受信すべきデータの最大滞留時間の大きい順、前記通信品質の良好な順、前記送信すべきデータ量又は受信すべきデータ量の少ない順に前記通信回線の割当順序を決定し、前記第２の無線端末については、前記通信品質の良好な順、前記送信すべきデータ量又は受信すべきデータ量の少ない順、前記送信すべきデータ又は受信すべきデータの最大滞留時間の大きい順に前記通信回線の割当順序を決定することを特徴とする通信回線割当方法。

【請求項１６】　請求項９乃至１５の何れかに記載の通信回線割当方法において、
前記割当順序を決定する手順は、前記各無線端末毎の受信側における通信品質に基づいて、前記通信装置と前記無線端末との間の通信回線の割当順序を決定する代わりに、前記各無線端末毎の受信側における通信品質に対応した、デジタル変調方式の変調多値数に基づいて、前記通信装置と前記無線端末との間の通信回線の割当順序を決定することを特徴とする通信回線割当方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、通信装置及び通信回線割当方法に関する。

【０００２】

【従来の技術】音声によるサービスが主体であった無線通信システムにおいて、近年、音声のみでなく、非音声のデータ通信や動画像及び静止画像のダウンロード等のいわゆるマルチメディアサービスに対する要求が高まってきている。このため、今後の無線通信システムには、マルチメディアサービスの提供が必要不可欠となっている。

【０００３】このようなマルチメディアサービスを実現する上では、音声のみの通信の場合よりもはるかに高速な通信が要求されるため、通信回線を有効に利用した効率的な伝送を行うシステムの設計が求められる。そのためには、通信品質の制御を行うことで、リソースの有効利用を図ることが重要となってくる。

【０００４】従来、このような効率的な伝送を図るための通信制御は、バッファに格納されたデータ量、及び許容される遅延時間に基づいた方法と、受信信号の信号対雑音電力比（ＳＮ比）に基づいた方法の何れか一方が採用されていた。これらの例を図１６、１７に示す。

【０００５】図１６は、バッファに格納されたデータ量、及び許容される遅延時間に基づいた通信回線割当方法を示すフローチャートである。時分割多重アクセスでは、各通信端末へ割り当てられる通信回線（チャネル）はタイムスロットと呼ばれる。

【０００６】無線基地局は、各バッファにパケットが格納されてからの経過時間（以下「遅延時間」と称する）を監視し、この遅延時間が許容される時間（以下「許容値」と称する）を超えたか否かを判定する（ステップ１５０１）。

【０００７】遅延時間が許容値を超えているパケットが存在する場合には、無線基地局は、その許容値を超えたパケットを受信する各無線端末に対して、遅延時間の大きい順にタイムスロットを割り当てる（ステップ１５０２）。次に、無線基地局は、遅延時間が許容値を超えて

いないパケットを受信する無線端末に対して、バッファ内のデータ量の少ない順にタイムスロットを割り当てる（ステップ１５０３）。

【０００８】また、全てのバッファ内のパケットの遅延時間が許容値を超えていない場合（ステップ１５０１で否定判断した場合）には、無線基地局は、各無線端末に対して、対応するバッファ内のデータ量の少ない順にタイムスロットを割り当てる（ステップ１５０３）。なお、ステップ１５０３において、バッファ内のデータ量の少ない順にタイムスロットを割り当てるのは、データ量が少なければ占有するタイムスロット数も少なくなるため、同時に接続することができる無線端末数の増加が見込めるからである。

【０００９】このように、遅延時間が許容値を超えたパケットを受信する無線端末に対して優先的にタイムスロットを割り当てることにより、遅延時間が増大することを防止し、効率的な伝送を行うことができる。

【００１０】一方、図１７は、受信信号のＳＮ比に基づいた通信回線割当方法を示すフローチャートである。無線基地局は、各無線端末から送られる受信ＳＮ比を常時観測し（ステップ１６０１）、この受信ＳＮ比の高い無線端末から順にタイムスロットを割り当てる（ステップ１６０２）。

【００１１】このように、通信品質が劣化しているために受信後のビット誤りやパケット誤り等が生じる可能性が高い場合には、対応する無線端末に対するタイムスロットの割り当ての優先度を低くすることにより、なるべく受信誤りを起こさないようにして効率的な伝送を行うことができる。

【００１２】

【発明が解決しようとする課題】しかし、図１６に示したバッファに格納されたデータ量、及び遅延時間に基づいた通信回線割当方法では、通信品質を考慮していないため、以下のような問題が生じる。

【００１３】例えばシャドウイング等の電波伝搬路の激しい変動のために通信品質が劣化し、受信側でパケット誤りが発生した場合を考えると、この場合には、その誤りが生じたパケットを再送すべく、図１６に示した方法により再度タイムスロットが割り当てられる。しかし、通信品質の劣化により、再度タイムスロットを割り当てたとしても再びパケット誤りが生じる。その結果、単位時間あたりに正しく送受信することができるデータ量、即ちスループットが低下し、システム全体における伝送効率が低下してしまう。

【００１４】一方、図１７に示した受信信号のＳＮ比に基づいた通信回線割当方法では、遅延時間を考慮していないため、通信品質が劣化している状態の無線端末に対しては、遅延に対する要求が厳しいものであっても、タイムスロットの割り当てが優先されない。このため、遅延に対する要求が厳しい無線端末であるにもかかわらず、無線基地局との接続ができなかったり、また、接続されたとしても途中で切断されたりといった事態が生じ、遅延が増大するという問題が生じる。

【００１５】本発明は、上述した問題に鑑みなされたものであり、通信回線の有効利用を図りつつ、遅延時間を所望の値以下に抑え、スループットを向上することを目的とする。

【００１６】

【課題を解決するための手段】上記の目的を達成するため、本発明の通信装置は、請求項１に記載されるように、複数の無線端末と通信を行うものであり、前記各無線端末毎の送信側における送信すべきデータ量と、前記各無線端末毎の受信側における通信品質とに基づいて、前記通信装置と前記無線端末との間の通信回線の割当順序を決定する割当順序決定手段と、前記決定された割当順序に従って、前記通信装置と前記無線端末との間の通信回線を割り当てる通信回線割当手段とを備える。

【００１７】このような通信装置では、各無線端末毎の送信側における送信すべきデータ量に基づいて、通信回線の割当順序を決定することにより、通信されるデータ量の少ない通信装置と無線端末との間に優先的に通信回線を割り当て、同時に接続する無線端末数を増加させることで、滞留時間等に問題のない無線端末を増やすことができる。併せて、各無線端末毎の受信側における通信品質に基づいて、通信回線の割当順序を決定することにより、通信品質の良好な通信装置と無線端末との間でデータを優先的に通信し、データの再送回数を減少させることでスループットを向上させることができる。なお、通信回線とは、時分割多重アクセス方式におけるタイムスロット、周波数分割多重アクセス方式における周波数帯域、符号分割多重アクセス方式における拡散コード等を意味する。

【００１８】また、本発明の通信装置は、請求項２に記載されるように、複数の無線端末と通信を行うものであり、前記各無線端末毎の送信側における送信すべきデータの最大滞留時間と、前記各無線端末毎の受信側における通信品質とに基づいて、前記通信装置と前記無線端末との間の通信回線の割当順序を決定する割当順序決定手段と、前記決定された割当順序に従って、前記通信装置と前記無線端末との間の通信回線を割り当てる通信回線割当手段とを備える。

【００１９】このような通信装置では、各無線端末毎の送信側における送信すべきデータの最大滞留時間に基づいて、通信回線の割当順序を決定することにより、滞留時間の大きいデータを優先的に伝送し、滞留時間を改善することができる。併せて、各無線端末毎の受信側における通信品質に基づいて、通信回線の割当順序を決定することにより、通信品質の良好な通信装置と無線端末との間でデータを優先的に通信し、データの再送回数を減少させることでスループットを向上させることができ

る。

【００２０】また、請求項３に記載された発明は、前記通信装置が送信側である場合を規定したものであり、請求項４に記載された発明は、前記通信装置が受信側である場合を規定したものである。

【００２１】また、本発明は請求項５に記載されるように、送信すべきデータ又は受信すべきデータの最大滞留時間が所定時間を超えた第１の無線端末と、送信すべきデータ又は受信すべきデータの最大滞留時間が所定時間を超えない第２の無線端末とに分類する無線端末分類手段を備え、前記割当順序決定手段は、前記第１の無線端末に対し、前記第２の無線端末に優先して前記通信回線の割当順序を決定するとともに、前記第１の無線端末については、前記送信すべきデータ又は受信すべきデータの最大滞留時間の大きい順、前記通信品質の良好な順に前記通信回線の割当順序を決定し、前記第２の無線端末については、前記通信品質の良好な順、前記送信すべきデータ又は受信すべきデータの最大滞留時間の大きい順に前記通信回線の割当順序を決定することにより、最大滞留時間の大きいものについては最大滞留時間の大きい順に通信回線が割り当てられ、最大滞留時間の小さいものについては通信品質の良好な順に通信回線が割り当てられるため、滞留時間の改善とスループットの向上との調和を図りつつ通信回線を割り当てることができる。

【００２２】また、本発明は請求項６に記載されるように、前記割当順序決定手段は、前記送信すべきデータの最大滞留時間及びデータ量と、前記通信品質とに基づいて、前記通信回線の割当順序を決定する。この場合には、通信されるデータ量の少ない通信装置と無線端末との間に優先的に通信回線を割り当て、同時に接続する無線端末数を増加させることで、滞留時間等に問題のない無線端末を増やすことができる。

【００２３】特に、請求項７に記載されるように、送信すべきデータ又は受信すべきデータの最大滞留時間が所定時間を超えた第１の無線端末と、送信すべきデータ又は受信すべきデータの最大滞留時間が所定時間を超えない第２の無線端末とに分類する無線端末分類手段を備え、前記割当順序決定手段は、前記第１の無線端末に対し、前記第２の無線端末に優先して前記通信回線の割当順序を決定するとともに、前記第１の無線端末については、前記送信すべきデータ又は受信すべきデータの最大滞留時間の大きい順、前記通信品質の良好な順、前記送信すべきデータ量又は受信すべきデータ量の少ない順に前記通信回線の割当順序を決定し、前記第２の無線端末については、前記通信品質の良好な順、前記送信すべきデータ量又は受信すべきデータ量の少ない順、前記送信すべきデータ又は受信すべきデータの最大滞留時間の大きい順に前記通信回線の割当順序を決定することにより、請求項５に記載された発明と同様、滞留時間の改善とスループットの向上との調和を図りつつ通信回線を割り当てることができ、併せて、同時に接続する無線端末数を増加させることで、滞留時間等に問題のない無線端末を増やすことができる。

【００２４】また、本発明は請求項８に記載されるように、前記割当順序決定手段は、前記各無線端末毎の受信側における通信品質に基づいて、前記通信装置と前記無線端末との間の通信回線の割当順序を決定する代わりに、前記各無線端末毎の受信側における通信品質に対応した、デジタル変調方式の変調多値数に基づいて、前記通信装置と前記無線端末との間の通信回線の割当順序を決定することにより、変調多値数を用いて、通信品質を用いた場合と同様に通信回線の割当順序を決定することができる。

【００２５】また、請求項９～１６に記載された発明は、請求項１～８に記載された通信装置に適した通信回線割当方法である。

【００２６】

【発明の実施の形態】以下、本発明の実施の形態を図面に基づいて説明する。図１は、本発明の実施の形態に係る通信装置及び通信回線割当方法が適用される無線通信システムの基本的な構成を示す図である。

【００２７】同図に示す無線通信システムでは、１つの無線基地局１と各無線端末１０、２０、３０、４０との間で通信が行われる。この無線基地局１と各無線端末１０～４０との間の通信に際しては、無線基地局１が各無線端末１０～４０に対し、時分割多重アクセス方式におけるタイムスロットを割り当てる制御を行う。

【００２８】無線基地局１は、接続される無線端末数分のバッファ１１、２１、３１、４１を備えている。バッファ１１には、無線端末１０へ送信されるパケットが格納される。同様に、バッファ２１～４１には、無線端末２０～４０へ送信されるパケットが格納される。一方、各無線端末１０～４０は、無線基地局１へ送信されるパケットを格納するバッファ１２、２２、３２、４２を備えている。

【００２９】図２は、無線基地局１から各無線端末１０～４０へパケットを伝送する際に、各無線端末１０～４０に対し、タイムスロットを割り当てる処理のブロック図である。

【００３０】各無線端末１０～４０は、受信部２０２において、無線基地局１から送信される信号を受信しており、ＳＮ比測定部２０４において、この受信信号のＳＮ比（受信ＳＮ比）を測定し、無線基地局１へ送信する。この受信ＳＮ比は、無線基地局１から各無線端末１０～４０へデータを伝送する通信回線の通信品質を示している。

【００３１】無線基地局１は、データ量測定部２０６において、無線基地局１内のバッファ１１～４１に格納されたデータ量を測定する。また、最大滞留時間測定部２０８において、バッファ１１～４１のそれぞれについ

て、最も長く滞留しているパケットの滞留時間（以下「最大滞留時間」と称する）を測定する。
【００３２】無線端末１０～４０における受信ＳＮ比、データ量測定部２０６によって測定されたバッファ１１～４１のデータ量、最大滞留時間測定部２０８によって測定されたバッファ１１～４１内のパケットの最大滞留時間の３つのパラメータは、スロット割当優先順序決定処理部２１２において、各無線端末１０～４０に対するタイムスロットの割当順序を決定する際に使用される。但し、割当順序を決定する前に、最大滞留時間による分類処理部２１０において、各無線端末１０～４０を、最大滞留時間が所定の許容時間を超えたバッファ内のパケットを送信する無線端末と、最大滞留時間が所定の許容時間を超えないバッファ内のパケットを送信する無線端末とに分類しておく。
【００３３】割当順序は以下のようにして決定される。スロット割当順序決定処理部２１０においては、最大滞留時間が所定の許容時間を超えたバッファ内のパケットを受信する無線端末については、タイムスロットの割当順序を、対応するバッファの最大滞留時間の大きい順、対応する受信ＳＮ比の大きい順、対応するバッファのデータ量の少ない順に決定し、続いて、最大滞留時間が所定の許容時間を超えないバッファ内のパケットを受信する無線端末については、タイムスロットの割当順序を、対応する受信ＳＮ比の大きい順、対応するバッファのデータ量の少ない順、対応するバッファ内のパケットの最大滞留時間の大きい順に決定する。
【００３４】このようにして、全ての無線端末１０～４０に対し、タイムスロットの割当順序が決定された後、スロット割当処理部３１４において、この割当順序に従って各無線端末１０～４０にタイムスロットを割り当てる処理を行い、送信部３１６において、割り当てられたタイムスロットを用いて、バッファ１１～４１に格納されているパケットを各無線端末１０～４０へ送信する。
【００３５】一方、図３は、各無線端末１０～４０から無線基地局１へパケットを伝送する際に、各無線端末１０～４０に対し、タイムスロットを割り当てる処理のブロック図である。
【００３６】各無線端末１０～４０は、送信部３０１において、所定の信号を無線基地局１へ送信している。また、データ量測定部３０６においては、内蔵するバッファ１２～４２のデータ量を測定し、無線基地局１へ送信する。最大滞留時間測定部３０８においては、内蔵するバッファ１２～４２内に最も長く滞留しているパケットの滞留時間（最大滞留時間）を測定し、無線基地局１へ送信する。
【００３７】無線基地局１は、ＳＮ比測定部３０４において、各無線端末１０～４０から受信した信号に関して各無線端末毎にＳＮ比を測定する。この受信ＳＮ比は、各無線端末１０～４０から無線基地局１へデータを伝送する通信回線の通信品質を示している。
【００３８】ＳＮ比測定部３０４によって測定された無線端末１０～４０における受信ＳＮ比、各無線端末１０～４０から送られたバッファ１２～４２内のパケットの最大滞留時間及びデータ量の３つのパラメータは、スロット割当優先順序決定処理部３１２において、各無線端末１０～４０に対するタイムスロットの割当順序を決定する際に使用される。但し、割当順序を決定する前に、最大滞留時間による分類処理部３１０において、各無線端末１０～４０を、最大滞留時間が所定の許容時間を超えたバッファ内のパケットを受信する無線端末と、最大滞留時間が所定の許容時間を超えないバッファ内のパケットを受信する無線端末とに分類しておく。
【００３９】割当順序は以下のようにして決定される。スロット割当順序決定処理部３１２においては、図２に示したスロット割当順序決定処理部２１２と同様に、最大滞留時間が所定の許容時間を超えたバッファ内のパケットを受信する無線端末については、タイムスロットの割当順序を、対応するバッファ内のパケットの最大滞留時間の大きい順、対応する受信ＳＮ比の大きい順、対応するバッファのデータ量の少ない順に決定し、続いて、最大滞留時間が所定の許容時間を超えないバッファ内のパケットを受信する無線端末については、タイムスロットの割当順序を、対応する受信ＳＮ比の大きい順、対応するバッファのデータ量の少ない順、対応するバッファ内のパケットの最大滞留時間の大きい順に決定する。
【００４０】このようにして、全ての無線端末１０～４０に対し、タイムスロットの割当順序が決定されると、スロット割当処理部３１４において、この割当順序に従って各無線端末１０～４０にタイムスロットを割り当てる処理を行う。各無線端末１０～４０は、割り当てられたタイムスロットを用いて、内蔵するバッファ１２～４２に格納されているパケットを無線基地局１へ送信する。
【００４１】上述した図２及び図３の実施形態におけるスロット割当の優先順序決定処理のフローチャートを図４に示す。
【００４２】受信ＳＮ比、バッファ内のデータ量、最大滞留時間の３つのパラメータを取得した後で、最大滞留時間が許容時間を超えたバッファ内のパケットを受信あるいは送信する無線端末（以下「最大滞留時間が許容時間を超えた無線端末」と称する）と、超えていないバッファ内のパケットを受信あるいは送信する無線端末（以下「最大滞留時間が許容時間を超えない無線端末」と称する）とに分類する処理までが第１段階である。その後、第２段階では、受信ＳＮ比、バッファ内のデータ量、パケットの最大滞留時間の３つのパラメータに基づくタイムスロットの割当処理が行われる。
【００４３】図４から明らかなように、最大滞留時間が許容時間を超えた無線端末が存在すれば、その無線端末

に優先的にタイムスロットを割り当てる処理を行い、その後、まだ空きスロットが存在すれば、最大滞留時間が許容時間を超えない無線端末にタイムスロットを割り当てる処理を行う。パケットの最大滞留時間が許容時間を超えた無線端末及び超えていない無線端末それぞれの詳細な処理の流れは図５及び図６に示している。無線基地局１は、各無線端末１０～４０に対して、バッファ内のパケットの最大滞留時間ならびに現在バッファ内に蓄積されているデータ量を、品質制御を行う周期ごとに把握する必要がある。なお、パケットの最大滞留時間が許容時間を超えた場合と超えない場合とで、第２段階におけるタイムスロットの割当順序が異なるが、いずれの場合においても、パケットの最大滞留時間を考慮して無線端末を分類する第１段階の処理は同じである。

【００４４】初めに図４の実施形態における第１段階の処理について説明する。最大滞留時間による分類処理部２１０、３１０は、取得された受信ＳＮ比、バッファ内のデータ量、パケットの最大滞留時間の３つのパラメータの内、パケットの最大滞留時間が許容時間を超えているか否かを判定し（ステップ４０１）、最大滞留時間が許容時間を超えた無線端末と超えていない無線端末とに分類する（ステップ４０２、４０３）。

【００４５】続いて第２段階の処理について説明する。まず、最大滞留時間が許容時間を超えた無線端末に対する処理が行われる（ステップ４０４）。これらの無線端末に対する処理の詳細を図５に示す。

【００４６】スロット割当優先順序決定処理部２１２、３１２は、無線端末の遅延時間を増大させないように、最大滞留時間の大きい無線端末に優先的にタイムスロットを割り当てるべく、各無線端末を最大滞留時間の大きい順にソートする（ステップ５０１）。このソートした順序がタイムスロットの割当順序になる。

【００４７】しかし、最大滞留時間が同一の値を持つ無線端末が複数存在する可能性がある。そこで、スロット割当優先順序決定処理部２１２、３１２は、最大滞留時間が同一の値を持つ無線端末が複数存在するか否かを判定し（ステップ５０２）、複数存在する場合には、これらの無線端末について、受信ＳＮ比の大きい順にソートを行い（ステップ５０３）、タイムスロットの割当順序を決定する。

【００４８】ここで、受信ＳＮ比についても、同一の値を持つ無線端末が複数存在する場合がある。そこで、スロット割当優先順序決定処理部２１２、３１２は、さらに受信ＳＮ比が同一の値を持つ無線端末が複数存在するか否かを判定し（ステップ５０４）、複数存在する場合には、これらの無線端末について、バッファ内のデータ量の少ない順にソートを行い（ステップ５０５）、タイムスロットの割当順序を決定する。

【００４９】このようにして最大滞留時間が許容時間を超えた全ての無線端末について、一意的にタイムスロットの割当順序が決定された後、スロット割当処理部２１４、３１４は、空きスロットがあるか否かを判定し（ステップ５０６）、空きスロットがあれば、その空きスロットを無線端末に割り当てる処理を行う（ステップ５０７）。

【００５０】これら空きスロットがあるか否かの判定処理（ステップ５０６）とタイムスロットの割当処理（ステップ５０７）は、最大滞留時間が許容時間を超えた全ての無線端末にタイムスロットを割り当てるか、若しくは空きスロットが無くなるまで繰り返される。なお、スロット割当処理部２１４、３１４は、空きスロットはあるものの、送信側のバッファ内の全てのパケットを伝送するだけの空きスロットがない場合には、最大滞留時間の大きいものから順にタイムスロットを割り当て、空きスロットがなくなった時点でタイムスロットの割当処理（ステップ５０７）を終了する。

【００５１】再び、図４に戻って説明する。最大滞留時間が許容時間を超えた無線端末に対する処理（ステップ４０４）の終了後、まだ空きスロットがあるか否かが判定され（ステップ４０５）、空きスロットがあれば、最大滞留時間が許容時間を超えない無線端末に対する処理（ステップ４０６）が行われる。これらの無線端末に対する処理の詳細を図６に示す。

【００５２】スロット割当優先順序決定処理部２１２、３１２は、受信ＳＮ比が大きい無線端末に対し、優先的にタイムスロットを割り当てるべく、各無線端末を受信ＳＮ比の大きい順にソートする（ステップ６０１）。このソートした順序がタイムスロットの割当順序になる。

【００５３】しかし、受信ＳＮ比が同一の値を持つ無線端末が複数存在する可能性があるため、スロット割当優先順序決定処理部２１２、３１２は、受信ＳＮ比が同一の値を持つ無線端末が複数存在するか否かを判定し（ステップ６０２）、複数存在する場合には、これらの無線端末について、バッファ内のデータ量の少ない順にソートを行い（ステップ６０３）、タイムスロットの割当順序を決定する。

【００５４】ここで、バッファ内のデータ量についても、同一の値を持つ無線端末が複数存在する場合があるため、スロット割当優先順序決定処理部２１２、３１２は、さらにバッファ内のデータ量が同一の値を持つ無線端末が複数存在するか否かを判定し（ステップ６０４）、複数存在する場合には、これらの無線端末について、最大滞留時間の大きい順にソートを行い（ステップ６０５）、タイムスロットの割当順序を決定する。

【００５５】このようにして最大滞留時間が許容時間を超えない全ての無線端末について、一意的にタイムスロットの割当順序が決定された後、スロット割当処理部２１４、３１４は、空きスロットがあるか否かを判定し（ステップ６０６）、空きスロットがあれば、その空きスロットを無線端末に割り当てる処理を行う（ステップ

６０７）。これら空きスロットがあるか否かの判定処理（ステップ６０６）とタイムスロットの割当処理（ステップ６０７）は、最大滞留時間が許容時間を超えない全ての無線端末にタイムスロットを割り当てるか、若しくは空きスロットが無くなるまで繰り返される。

【００５６】以上詳細に説明したように、パケットの最大滞留時間に基づいて、滞留時間の大きいパケットを優先的に伝送し、滞留時間を改善することができる。また、受信ＳＮ比に基づいて、該受信ＳＮ比の良好な無線基地局１と無線端末との間でパケットを優先的に通信し、パケットの再送回数を減少させることでスループットを向上させることができる。更に、バッファ内のデータ量に基づいて、データ量の少ない通信されるデータ量の少ない無線基地局１と無線端末との間に優先的に通信回線を割り当て、同時に接続する無線端末数を増加させることで、滞留時間に問題のない無線端末を増やすことができる。

【００５７】ところで、受信ＳＮ比の代わりに、変調多値数に基づいてタイムスロットの割当順序を決定することもできる。図７は、無線基地局１から各無線端末１０～４０へパケットを伝送する際に、要求される通信品質を満足するように変調多値数を決定して、各無線端末１０～４０に対し、タイムスロットを割り当てる処理のブロック図である。

【００５８】各無線端末１０～４０は、受信部７０２において、図２に示した受信部２０２と同様、無線基地局１から送信される信号を受信し、ＳＮ比測定部７０４において、この受信信号のＳＮ比（受信ＳＮ比）を測定し、無線基地局１へ送信する。

【００５９】無線基地局１は、多値数決定部７０５において、各無線端末１０～４０から送られた受信ＳＮ比において、要求されている通信品質（例えばビット誤り率やパケット誤り率）を満足することができるか否かを判定し、満足しない場合には、変調多値数を下げる処理を行う。

【００６０】多値数決定部７０５によって決定された無線端末１０～４０毎の変調多値数、データ量測定部７０６によって測定されたバッファ１１～４１のデータ量、最大滞留時間測定部７０８によって測定されたバッファ１１～４１内のパケットの最大滞留時間の３つのパラメータは、スロット割当優先順序決定処理部７１２において、各無線端末１０～４０に対するタイムスロットの割当順序を決定する際に使用される。但し、割当順序を決定する前に、最大滞留時間による分類処理部７１０において、各無線端末１０～４０を、最大滞留時間が所定の許容時間を超えたバッファ内のパケットを受信する無線端末と、最大滞留時間が所定の許容時間を超えないバッファ内のパケットを受信する無線端末とに分類しておく。

【００６１】割当順序は以下のようにして決定される。

スロット割当順序決定処理部７１２においては、最大滞留時間が所定の許容時間を超えたバッファ内のパケットを受信する無線端末については、タイムスロットの割当順序を、対応するバッファの最大滞留時間の大きい順、対応する変調多値数の大きい順、対応するバッファのデータ量の少ない順に決定し、続いて、最大滞留時間が所定の許容時間を超えないバッファ内のパケットを受信する無線端末については、タイムスロットの割当順序を、対応する変調多値数の大きい順、対応するバッファのデータ量の少ない順、対応するバッファ内のパケットの最大滞留時間の大きい順に決定する。

【００６２】このようにして、全ての無線端末１０～４０に対し、タイムスロットの割当順序が決定された後、スロット割当処理部７１４において、この割当順序に従って各無線端末１０～４０にタイムスロットを割り当てる処理を行い、送信部７１６において、割り当てられたタイムスロットを用いて、バッファ１１～４１に格納されているパケットを各無線端末１０～４０へ送信する。

【００６３】一方、図８は、各無線端末１０～４０から無線基地局１へパケットを伝送する際に、要求される通信品質を満足するように変調多値数を決定して、各無線端末１０～４０に対し、通信回線を割り当てる処理のブロック図である。

【００６４】各無線端末１０～４０は、送信部８０１において、所定の信号を無線基地局１へ送信している。また、データ量測定部８０６においては、内蔵するバッファ１２～４２のデータ量を測定し、無線基地局１へ送信する。最大滞留時間測定部８０８においては、内蔵するバッファ１２～４２内に最も長く滞留しているパケットの滞留時間（最大滞留時間）を測定し、無線基地局１へ送信する。

【００６５】無線基地局１は、ＳＮ比測定部８０４において、各無線端末１０～４０から受信した信号に関して各無線端末毎にＳＮ比を測定する。また、多値数決定部８０５において、これら受信ＳＮ比において、要求されている通信品質を満足することができるか否かを判定し、満足しない場合には、変調多値数を下げる処理を行う。

【００６６】多値数決定部８０５によって決定された無線端末１０～４０毎の変調多値数、各無線端末１０～４０から送られたバッファ１２～４２内のパケットの最大滞留時間及びデータ量の３つのパラメータは、スロット割当優先順序決定処理部８１２において、各無線端末１０～４０に対するタイムスロットの割当順序を決定する際に使用される。但し、割当順序を決定する前に、最大滞留時間による分類処理部８１０において、各無線端末１０～４０を、最大滞留時間が所定の許容時間を超えたバッファ内のパケットを受信する無線端末と、最大滞留時間が所定の許容時間を超えないバッファ内のパケットを受信する無線端末とに分類しておく。

【００６７】割当順序は以下のようにして決定される。スロット割当順序決定処理部８１２においては、図７に示したスロット割当順序決定処理部７１２と同様に、最大滞留時間が所定の許容時間を超えたバッファ内のパケットを受信する無線端末については、タイムスロットの割当順序を、対応するバッファの最大滞留時間の大きい順、対応する変調多値数の大きい順、対応するバッファのデータ量の少ない順に決定し、続いて、最大滞留時間が所定の許容時間を超えないバッファ内のパケットを受信する無線端末については、タイムスロットの割当順序を、対応する変調多値数の大きい順、対応するバッファのデータ量の少ない順、対応するバッファ内のパケットの最大滞留時間の大きい順に決定する。

【００６８】このようにして、全ての無線端末１０～４０に対し、タイムスロットの割当順序が決定された後、スロット割当処理部８１４において、この割当順序に従って各無線端末１０～４０にタイムスロットを割り当てる処理を行う。各無線端末１０～４０は、割り当てられたタイムスロットを用いて、内蔵するバッファ１２～４２に格納されているパケットを無線基地局１へ送信する。

【００６９】上述した図７及び図８の実施形態におけるスロット割当の優先順序決定処理のフローチャートを図９に示す。

【００７０】受信ＳＮ比、バッファ内のデータ量、最大滞留時間の３つのパラメータを取得した後で、受信ＳＮ比が要求される受信品質を満足しない場合には、対応する無線端末の変調多値数を下げ、最大滞留時間が許容時間を超えた無線端末と、最大滞留時間が許容時間を超えない無線端末とに分類する処理までが第１段階である。その後、第２段階では、変調多値数、バッファ内のデータ量、最大滞留時間の３つのパラメータに基づくタイムスロットの割当処理が行われる。

【００７１】図９から明らかなように、最大滞留時間が許容時間を超えた無線端末が存在すれば、その無線端末に優先的にタイムスロットを割り当てる処理を行い、その後、まだ空きスロットが存在すれば、最大滞留時間が許容時間を超えない無線端末にタイムスロットを割り当てる処理を行う。パケットの最大滞留時間が許容時間を超えた無線端末ならびに超えていない無線端末それぞれの詳細な処理の流れは図１１及び図１２に示している。無線基地局１は、各無線端末１０～４０に対して、バッファ内のパケットの最大滞留時間ならびに現在バッファ内に蓄積されているデータ量を、品質制御を行う周期ごとに把握する必要がある。なお、パケットの最大滞留時間が許容時間を超えた場合と超えない場合とで、第２段階におけるタイムスロットの割当順序が異なるが、いずれの場合においても、パケットの最大滞留時間を考慮して無線端末を分類する第１段階の処理は同じである。

【００７２】また、本実施形態では、一定周期ごとに取得した受信ＳＮ比により変調多値数を決定する処理と、タイムスロットの割当順序を決定する処理即ちタイムスロットを割り当てる処理とを独立に行うことができる。例えば、受信信号の変動が激しい環境では、受信ＳＮ比を取得し、変調多値数を決定する頻度を多くすることができる。一方、タイムスロットの割当順序を決定する頻度は、トラヒックの変動の速さに応じて決めることができる。この場合、タイムスロットを割り当てる際に必要な変調多値数の情報は、割当処理を行う時点での変調多値数を用いる。

【００７３】但し、変調多値数を決定する処理の周期と、タイムスロットを割り当てる処理の周期とが一致する場合には、通信回線の利用効率を高めることができる。従って、ここでは変調多値数を決定する処理と、タイムスロットを割り当てる処理とを同一周期で行う場合について説明する。

【００７４】初めに図９の実施形態における第１段階の処理について説明する。多値数決定部７０５、８０５は、取得した受信ＳＮ比に着目し、受信ＳＮ比が所要値を満足しているか否かを判定する（ステップ９０１）、所要値を満足していない場合には、多値数決定部７０５、８０５は、対応する無線端末の変調多値数を下げる処理を行う（ステップ９０２）。

【００７５】接続中の無線端末は、一度に送信することのできる情報量を多くして通信回線の利用効率を高めるために、前回の多値数決定処理において、使用可能な最大の変調多値数が決定されて用いられる。即ち、受信信号の電力及び雑音・干渉電力を測定し、受信ＳＮ比を求める。そして、この受信ＳＮ比において、要求される受信品質の１つであるビット誤り率やパケット誤り率を満たすことができる最大の変調多値数が決定され、以降の通信に用いられている。

【００７６】しかし、無線通信の電波環境では、通信中にも受信ＳＮ比は常に変動しており、また、変調多値数が大きくなるほど雑音や干渉に弱くなってビット誤り率やパケット誤り率が増加する。従って、受信信号の変動や干渉電力の増大等により、受信ＳＮ比が所要値を下回った場合には、そのままではビット誤り率等を満足することができなくなるため、変調多値数を下げることにより、通信回線の利用効率を犠牲にしても通信品質を維持するようにする。

【００７７】変調多値数を下げる処理について図１０に例を挙げて説明する。同図のグラフは、様々な変調多値数ｎにおける、受信ＳＮ比と要求される通信品質（ビット誤り率：ＢＥＲ）との関係を表したものである。図１０に示した例では、前回変調多値数を決定した時点における受信ＳＮ比では、ここに挙げたｎ＝４～２５６の何れの変調多値数を用いても要求されるビット誤り率を満足することができる。但し、通信回線を効率よく使用すべく、なるべく大きな変調多値数を用いる必要があるた

め、ｎ＝２５６とし、ｎ＝２５６における所要の受信ＳＮ比を求めておく。

【００７８】そして、その後の受信信号の変動や干渉電力の増大等により、現在の受信ＳＮ比がｎ＝２５６における所要の受信ＳＮ比を下回った場合には、要求されるビット誤り率を満足することができなくなる。そこで、変調多値数ｎ＝２５６を、現在の受信ＳＮ比において、要求されるビット誤り率を満足する最大の変調多値数である、ｎ＝６４に下げる。さらにｎ＝６４における所要の受信ＳＮ比を求め、以降の変調多値数の決定処理が行われる毎に、その時点での受信ＳＮ比との比較を行う。

【００７９】ここで、受信ＳＮ比とビット誤り率との関係はシステムの電波環境に最も近い理論値を用いることができる。また、変調多値数の決定を行う無線基地局に、予めこのような電波伝搬路の特性に関する情報をテーブルとして備えておき、変調多値数決定時に参照するようにしてもよい。

【００８０】なお、あらかじめシステムにおいて定められた最小の変調多値数を使用している場合には、それ以上変調多値数を下げることはせず次の処理を行う。

【００８１】再び図９に戻って説明する。上述したように、受信ＳＮ比に基づいて変調多値数が決定された後、最大滞留時間による分類処理部７１０、８１０は、変調多値数、バッファ内のデータ量、最大滞留時間の３つのパラメータの内、最大滞留時間が許容時間を超えているか否かを判定し（ステップ９０３）、最大滞留時間が許容時間を超えた無線端末と超えていない無線端末とに分類する（ステップ９０４、９０５）。

【００８２】続いて第２段階の処理について説明する。まず、最大滞留時間が許容時間を超えた無線端末に対する処理が行われる（ステップ９０６）。これらの無線端末に対する処理の詳細を図１１に示す。

【００８３】スロット割当優先順序決定処理部７１２、８１２は、無線端末の遅延時間を増大させないように、最大滞留時間の大きい無線端末に優先的にタイムスロットを割り当てるべく、各無線端末を最大滞留時間の大きい順にソートする（ステップ１１０１）。このソートした順序がタイムスロットの割当順序になる。

【００８４】しかし、最大滞留時間が同一の値を持つ無線端末が複数存在する可能性があるため、スロット割当優先順序決定処理部７１２、８１２は、最大滞留時間が同一の値を持つ無線端末が複数存在するか否かを判定し（ステップ１１０２）、複数存在する場合には、これらの無線端末について、変調多値数の大きい順にソートを行い（ステップ１１０３）、タイムスロットの割当順序を決定する。

【００８５】ここで、変調多値数についても、同一の値を持つ無線端末が複数存在する場合があるため、スロット割当優先順序決定処理部７１２、８１２は、さらに変調多値数が同一の値を持つ無線端末が複数存在するか否かを判定し（ステップ１１０４）、複数存在する場合には、これらの無線端末について、バッファ内のデータ量の少ない順にソートを行い（ステップ１１０５）、タイムスロットの割当順序を決定する。

【００８６】このようにして最大滞留時間が許容時間を超えた全ての無線端末について、一意的にタイムスロットの割当順序が決定された後、スロット割当処理部７１４、８１４は、空きスロットがあるか否かを判定し（ステップ１１０６）、空きスロットがあれば、その空きスロットを無線端末に割り当てる処理を行う（ステップ１１０７）。これら空きスロットがあるか否かの判定処理（ステップ１１０６）とタイムスロットの割当処理（ステップ１１０７）は、最大滞留時間が許容時間を超えた全ての無線端末にタイムスロットを割り当てるか、若しくは空きスロットが無くなるまで繰り返される。

【００８７】再び、図９に戻って説明する。最大滞留時間が許容時間を超えた無線端末に対する処理（ステップ９０６）の終了後、まだ空きスロットがあるか否かが判定され（ステップ９０７）、空きスロットがあれば、最大滞留時間が許容時間を超えない無線端末に対する処理（ステップ９０８）が行われる。これらの無線端末に対する処理の詳細を図１２に示す。

【００８８】スロット割当優先順序決定処理部７１２、８１２は、変調多値数が大きい無線端末に対し、優先的にタイムスロットを割り当てるべく、各無線端末を変調多値数の大きい順にソートする（ステップ１２０１）。このソートした順序がタイムスロットの割当順序になる。

【００８９】しかし、変調多値数が同一の値を持つ無線端末が複数存在する可能性があるため、スロット割当優先順序決定処理部７１２、８１２は、変調多値数が同一の値を持つ無線端末が複数存在するか否かを判定し（ステップ１２０２）、複数存在する場合には、これらの無線端末について、バッファ内のデータ量の少ない順にソートを行い（ステップ１２０３）、タイムスロットの割当順序を決定する。

【００９０】ここで、バッファ内のデータ量についても、同一の値を持つ無線端末が複数存在する場合があるため、スロット割当優先順序決定処理部７１２、８１２は、さらにバッファ内のデータ量が同一の値を持つ無線端末が複数存在するか否かを判定し（ステップ１２０４）、複数存在する場合には、これらの無線端末について、最大滞留時間の大きい順にソートを行い（ステップ１２０５）、タイムスロットの割当順序を決定する。

【００９１】このようにして最大滞留時間が許容時間を超えない全ての無線端末について、一意的にタイムスロットの割当順序が決定された後、スロット割当処理部７１４、８１４は、空きスロットがあるか否かを判定し（ステップ１２０６）、空きスロットがあれば、その空きスロットを無線端末に割り当てる処理を行う（ステッ

ブ１２０７）。これら空きスロットがあるか否かの判定処理（ステップ１２０６）とタイムスロットの割当処理（ステップ１２０７）は、最大滞留時間が許容時間を超えない全ての無線端末にタイムスロットを割り当てるか、若しくは空きスロットが無くなるまで繰り返される。

【００９２】ここで、各無線端末にタイムスロットを割り当てる際のスロット数の決定方法について説明する。図１３は、時分割多重アクセス方式のタイムスロット構成を示す図である。バッファ内のデータ量に関する情報は、制御用系列（ＣＳ）により送られる。ここではバッファ内のデータ量をＤ（bits）とする。

【００９３】変調多値数をｎ、１シンボルでＮ（bits）の情報を送ることができるものとすると、$N=\log_2 n$なる関係となる。１つのスロットで送信できるシンボル数（システムの帯域によって決まる）をＳ（symbols）とすると、１つのスロットで送信できるビット数はＳＮ（bits）となる。

【００９４】従って、バッファ内のＤ（bits）を送信するために割り当てるべきスロット数は、$D/(SN)=D/(S\log_2 n)$となる。即ち、変調多値数ｎが大きいほど、割り当てるスロット数が少なくて済み、通信回線を効率よく使用することができる。無線基地局１では、決定された割当順序に従い、各無線端末に対し、必要なタイムスロット数分の空きスロットを割り当てる処理が行われる。

【００９５】次に、バッファ内のパケットの最大滞留時間を求める方法について説明する。無線基地局から各無線端末へパケットを送信する際は、送信側である無線基地局内のバッファに送信されるパケットが格納され、一方、各無線端末から無線基地局へパケットを送信する際は、送信側である各無線端末内のバッファに送信されるパケットが格納される。これらのバッファは、ＦＩＦＯ（First-In First-Out）のキューに相当する。格納される各パケットのヘッダ部にはパケットの発生時刻が記述される。

【００９６】新たに発生したパケットは、順序良くバッファの最後尾に置かれるため、最前列のパケット、即ち、次にバッファから送出されるべきパケットの滞留時間（パケットが発生してからの経過時間）は、バッファ内の全てのパケットの滞留時間の中で最も長いものとなる。従って、バッファの最前列のパケットの滞留時間を最大滞留時間と定義することができる。各無線端末から無線基地局へパケットを送信する際は、各無線端末は、無線基地局１に、この最大滞留時間を通知する必要がある。

【００９７】続いて、無線基地局と無線端末との接続開始から終了までの流れを、図１４及び図１５を用いて説明する。

【００９８】図１４は、無線基地局が送信側、無線端末が受信側となる場合の例である。まず、接続を開始する際、送信側は受信側に対し、接続要求のための制御信号を送信する。受信側は、この接続要求に応答するとともに、所定の通信品質を要求する場合には、その要求する通信品質（以下「要求品質」と称する）についても、同時に通知する。ここで要求品質とは、所要のビット誤り率（ＢＥＲ）及びパケットの最大滞留時間の許容時間であり、受信側がこれらを要求する場合には、最初の接続の際にのみ送信側へ通知すればよい。

【００９９】受信側から接続要求に対する応答が返ってきた場合には、送信側は、タイムスロットの割当順序を決定するためのパラメータを要求する。受信側は、この要求に応じて、受信ＳＮ比をパラメータとして通知する。

【０１００】送信側は、この通知された受信ＳＮ比と、その時点でのバッファ内のデータ量及びバッファ内のパケットの最大滞留時間に基づいて、図４又は図９に示した方法により、各無線端末毎へ割り当てるタイムスロット数を決定するとともに、その割当順序を決定し、各無線端末にタイムスロットを割り当てる。また、変調多値数を可変とする場合には、受信側は、図１０に示した方法により、変調多値数を決定するとともに、その変調多値数における所要の受信ＳＮ比を決定する。

【０１０１】送信側は、受信側に対し、割り当てられたタイムスロットや変更された変調多値数を通知する。そして、受信側からこれらに対する応答が帰ってきた場合には、送信側は、バッファに格納されたパケットの送信を開始する。

【０１０２】受信側は、パケットを受信すると、その時点での受信ＳＮ比をパラメータとして通知する。送信側は、この通知された受信ＳＮ比と、その時点でのバッファ内のデータ量及びバッファ内のパケットの最大滞留時間に基づいて、再度、各無線端末へタイムスロットを割り当てる際の割当順序を決定する。このようにして１フレーム毎に、各無線端末へタイムスロットを割り当てる際の割当順序が更新され、接続が終了するまで繰り返される。

【０１０３】なお、受信ＳＮ比から変調多値数を決定する処理及びタイムスロットの割当順序を決定する処理は、前述したように同一周期でなくてもよい。また、これらの処理は必ずしも１フレーム毎に処理する必要はなく、数フレーム単位で処理することも可能である。処理の周期が短いほどシステム特性は良くなると考えられるが、処理が煩雑になるので、システム設計の際に最適な処理の間隔を決めるようにすればよい。但し、無線基地局にカバーする全ての無線端末からの信号が到着するには、１フレーム分の時間が必要であるため、最低でも１フレーム分の周期が必要である。

【０１０４】一方、図１５は、無線端末が送信側、無線基地局が受信側となる場合の例である。まず、接続を開

始する際、送信側は受信側に対し、接続要求のための制御信号を送信する。送信側が所定の通信品質を要求する場合には、その要求品質についても受信側に通知する。

【０１０５】受信側から接続要求に対する応答が返ってきた場合には、送信側は、タイムスロットの割当順序を決定するためのパラメータを通知する。ここで通知されるパラメータは、その時点でのバッファ内のデータ量やバッファ内のパケットの最大滞留時間である。受信側は、これら通知されたパラメータと受信ＳＮ比に基づいて、図４又は図９に示した方法により、各無線端末毎へ割り当てるタイムスロット数を決定するとともに、その割当順序を決定し、各無線端末にタイムスロットを割り当てる。また、変調多値数を可変とする場合には、受信側は、図１０に示した方法により、変調多値数を決定するとともに、その変調多値数における所要の受信ＳＮ比を決定する。

【０１０６】受信側から割り当てられたタイムスロットや変更された変調多値数が通知されると、送信側は、バッファに格納されたパケットの送信を開始する。その際、送信側は、バッファ内のデータ量やバッファ内のパケットの最大滞留時間も併せて通知する。受信側は、再度これら通知されたパラメータと受信ＳＮ比に基づいて、各無線端末へタイムスロットを割り当てる際の割当順序を決定する。このようにして１フレーム毎に、各無線端末へタイムスロットを割り当てる際の割当順序が更新され、接続が終了するまで繰り返される。

【０１０７】なお、通信回線割当方法を示す上述した実施形態では、受信ＳＮ比、データ量及びパケットの最大滞留時間の３つのパラメータに基づいて、割当順序を決定したが、受信ＳＮ比とデータ量の２つのパラメータに基づいて割当順序を決定しても良く、また、受信ＳＮ比とパケットの最大滞留時間の２つのパラメータに基づいて割当順序を決定しても良い。

【０１０８】また、通信回線割当方法を示す上述した実施形態では、時分割多重アクセス方式におけるタイムスロットを割り当てる場合について説明したが、同様に、周波数分割多重アクセス方式における周波数帯域や、符号分割多重アクセス方式における拡散コード等を割り当てることもできる。

【発明の効果】上述の如く、本願発明における通信品質制御は、通信品質のみならず各無線端末の滞留時間も一定の値以下に抑えられ、併せてスループットも向上させて、良好な無線通信システムを提供することができる。

【０１０９】また、無線通信回線の品質をフレーム毎に観測しており、通信品質の良好なものからタイムスロットを割り当てるので、パケットを再送する確率を十分小さくでき、かつ大きな変調多値数を使用することでスループットが良くなり、周波数利用効率も良くなる。また、品質が良好でないものも、変調多値数を下げて、ある一定のビット誤り率を超えないように制御することで通信可能となる。従って、本願発明による品質制御を行うシステムは、無線端末を使用する側から見てもシステムを運用する側から見ても、非常に良好なシステムである。

【０１１０】さらに、データ量の少ないものに優先権を与えることでより多くの無線端末が同時に接続可能となる。送信データ量の多い端末は必要となるタイムスロット数も多いため、どうしても滞留時間が大きくなるが、滞留時間がある規定値を超えれば、これらの無線端末に優先的にタイムスロットが割り当てられるため、これらの無線端末の滞留時間も大きく発散することはない。

【図面の簡単な説明】

【図１】本発明の実施の形態に係る通信装置及び通信回線割当方法が適用される無線通信システムの基本的な構成を示す図である。

【図２】無線基地局から各無線端末へパケットを伝送する際に、各無線端末に対し、通信回線を割り当てる処理のブロック図である。

【図３】各無線端末から無線基地局へパケットを伝送する際に、各無線端末に対し、通信回線を割り当てる処理のブロック図である。

【図４】図２及び図３の実施形態におけるスロット割当の優先順序決定処理のフローチャートである。

【図５】図４のうち、最大滞留時間が許容時間を超えた無線端末に対する処理の詳細を示すフローチャートである。

【図６】図４のうち、最大滞留時間が許容時間を超えない無線端末に対する処理の詳細を示すフローチャートである。

【図７】無線基地局から各無線端末へパケットを伝送する際に、要求される通信品質を満足するように変調多値数を決定して、各無線端末に対し、通信回線を割り当てる処理のブロック図である。

【図８】各無線端末から無線基地局へパケットを伝送する際に、要求される通信品質を満足するように変調多値数を決定して、各無線端末に対し、通信回線を割り当てる処理のブロック図である。

【図９】図７及び図８の実施形態におけるスロット割当の優先順序決定処理のフローチャートである。

【図１０】様々な変調多値数における、受信ＳＮ比と要求される通信品質との関係を表した図である。

【図１１】図９のうち、最大滞留時間が許容時間を超えた無線端末に対する処理の詳細を示すフローチャートである。

【図１２】図９のうち、最大滞留時間が許容時間を超えない無線端末に対する処理の詳細を示すフローチャートである。

【図１３】時分割多重アクセス方式のタイムスロット構成を示す図である。

【図１４】無線基地局が送信側、無線端末が受信側とな

る場合の接続開始から終了までの流れの一例を示すシーケンス図である。

【図１５】無線端末が送信側、無線基地局が受信側となる場合の接続開始から終了までの流れの一例を示すシーケンス図である。

【図１６】従来の、バッファに格納されたデータ量及び許容される遅延時間に基づいた通信回線割当方法のフローチャートである。

【図１７】従来の、受信ＳＮ比に基づいた通信回線割当方法のフローチャートである。

【符号の説明】

１　無線基地局１０、２０、３０、４０　無線端末

１１、１２、２１、２２、３１、３２、４１、４２　バッファ

２０２、７０２　受信部

２０４、３０４、７０４、８０４　ＳＮ比測定部

２０６、３０６、７０６、８０６　データ量測定部

２０８、３０８、７０８、８０８　最大滞留時間測定部

２１０、３１０、７１０、８１０　最大滞留時間による分類処理部

２１２、３１２、７１２、８１２　スロット割当優先順序決定処理部

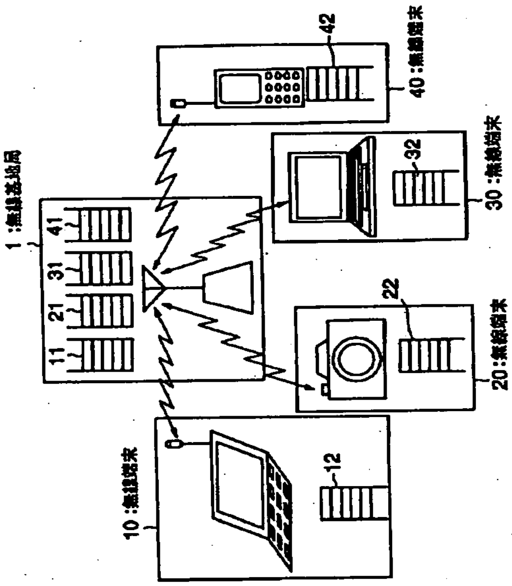
２１４、３１４、７１４、８１４　スロット割当処理部

２１６、３０１、３１６、７１６、８０１、８１６　送信部

７０５、８０５　多値数決定部

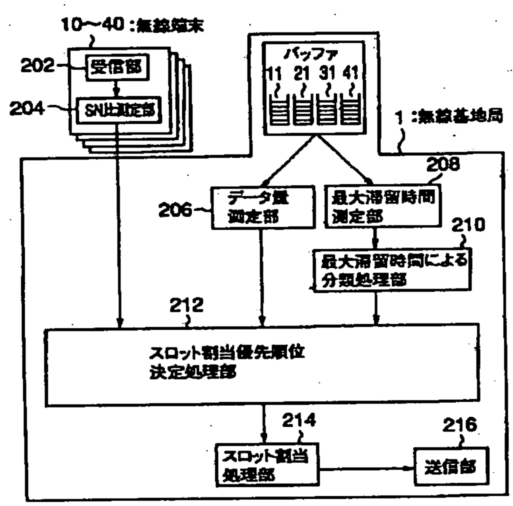
【図１】

本発明の実施の形態に係る通信装置及び方法が適用される無線通信システムの基本的な構成を示す図



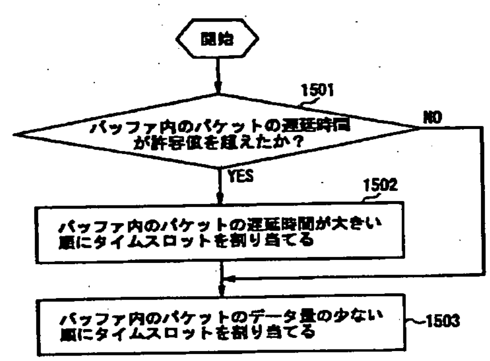
【図２】

無線基地局から各無線端末へパケットを伝送する際に、各無線端末に対し、通信回線を割り当てる処理のブロック図



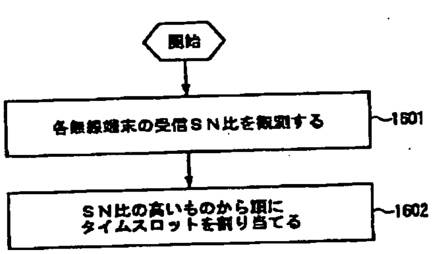
【図１６】

従来の、バッファに格納されたデータ量及び許容される遅延時間に基づいた通信回線割当方法のフローチャート



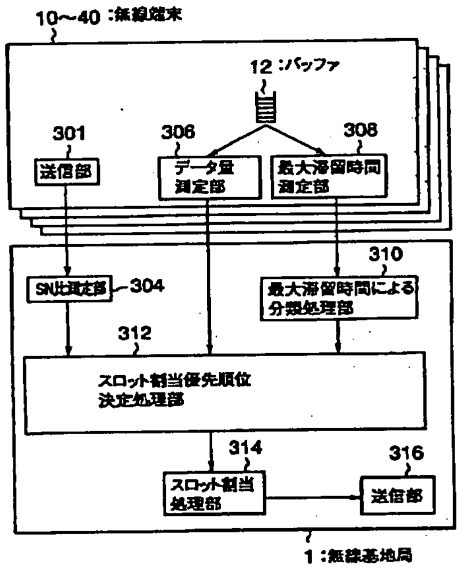
【図１７】

従来の、受信ＳＮ比に基づいた通信回線割当方法のフローチャート



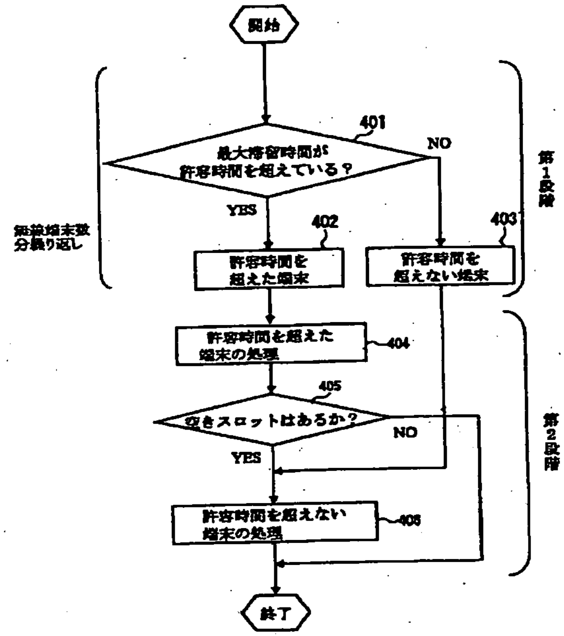
【図３】

各無線端末から無線基地局へパケットを伝送する際に、各無線端末に対し、通信回線を割り当てる処理のブロック図



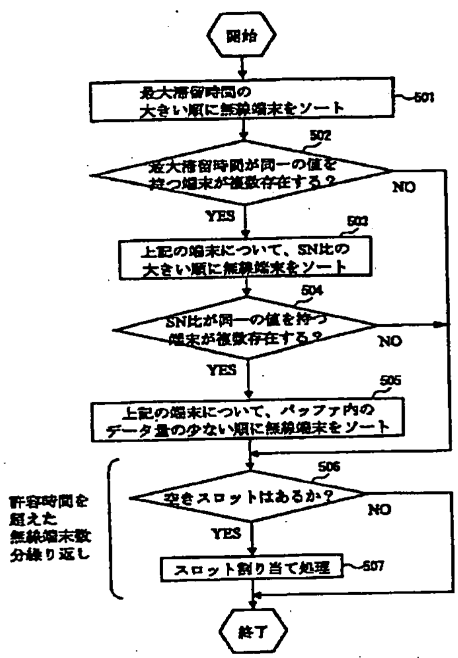
【図４】

図２及び図３の実施形態におけるスロット割当の優先順序決定処理のフローチャート



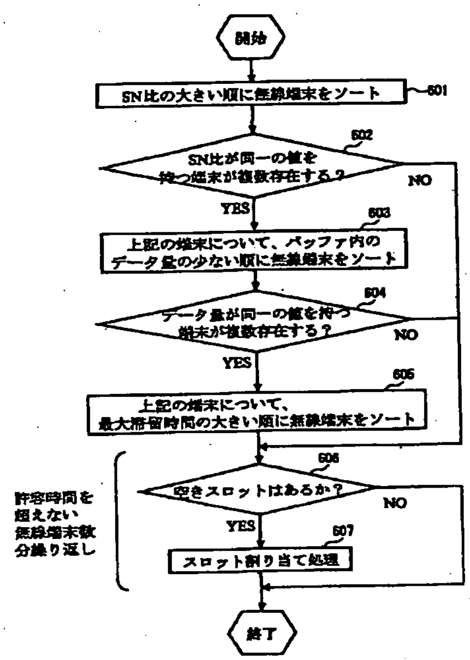
【図５】

図４のうち、最大滞留時間が許容時間を超えた無線端末に対する処理の詳細を示すフローチャート



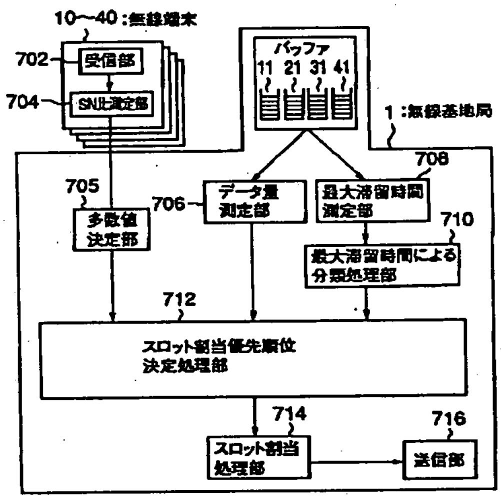
【図６】

図４のうち、最大滞留時間が許容時間を超えない無線端末に対する処理の詳細を示すフローチャート



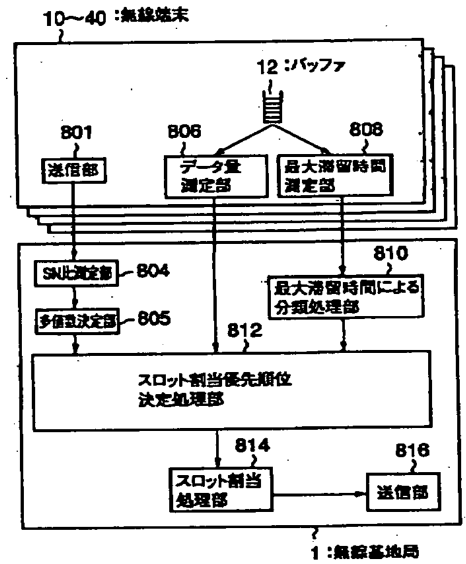
【図７】

無線基地局から各無線端末へパケットを伝送する際に、要求される通信品質を満足するように変調多値数を決定して、各無線端末に対し、通信回線を割り当てる処理のブロック図



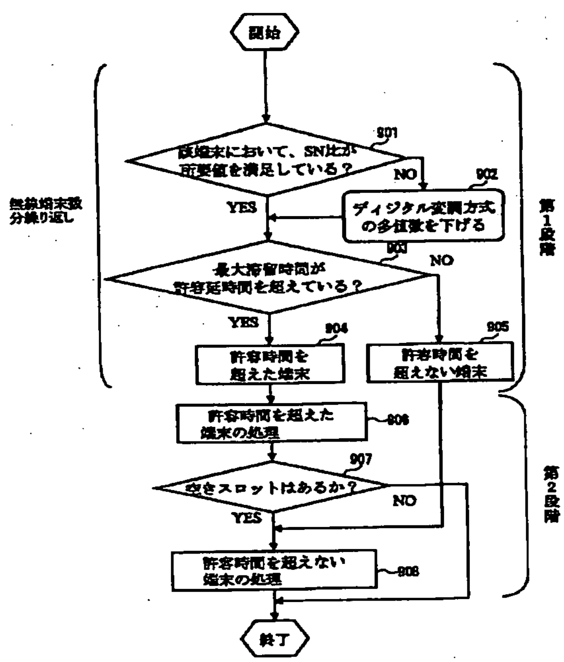
【図８】

各無線端末から無線基地局へパケットを伝送する際に、要求される通信品質を満足するように変調多値数を決定して、各無線端末に対し、通信回線を割り当てる処理のブロック図



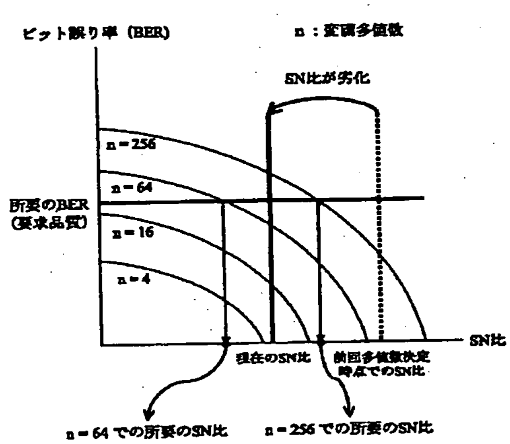
【図９】

図７及び図８の実施形態におけるスロット割当の優先順序決定処理のフローチャート



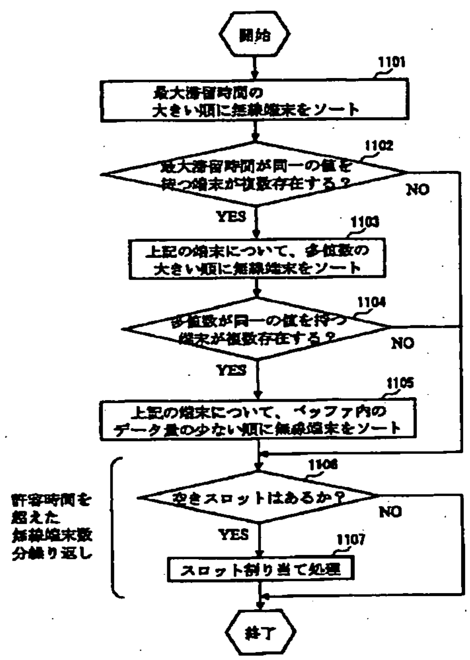
【図１０】

様々な変調多値数における、受信ＳＮ比と要求される通信品質との関係を表した図



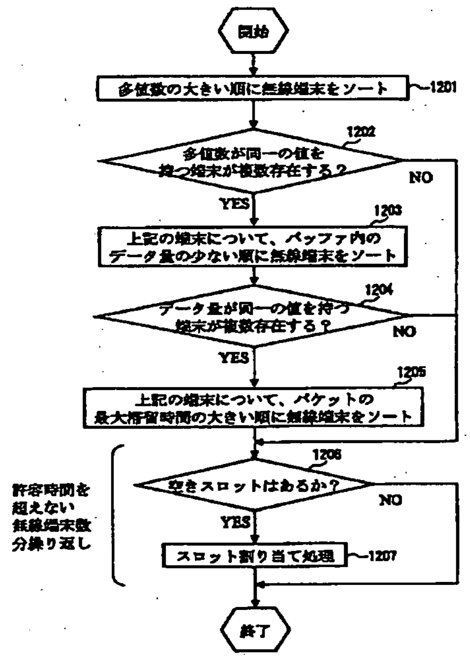
【図１１】

図９のうち、最大滞留時間が許容時間を超えた
無線端末に対する処理の詳細を示すフローチャート



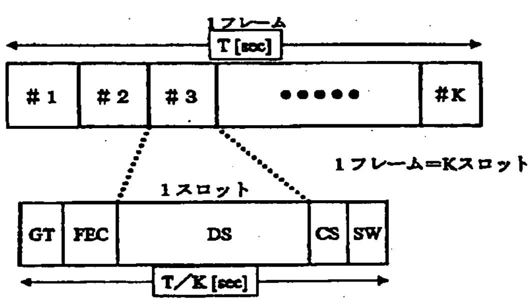
【図１２】

図９のうち、最大滞留時間が許容時間を超えない
無線端末に対する処理の詳細を示すフローチャート



【図１３】

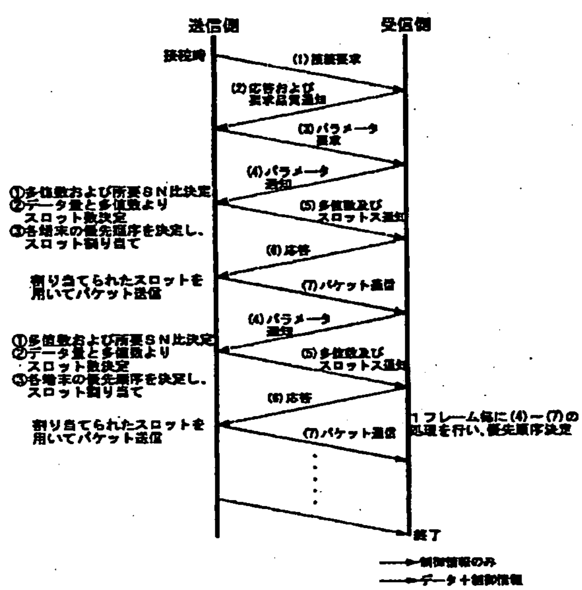
時分割多重アクセス方式のタイムスロット構成を示す図



SW：同期ワード
CS：制御用系列
（優先順序決定のための
パラメータに関する情報含む）
DS：データ系列
FEC：誤り訂正等
GT：ガードタイム

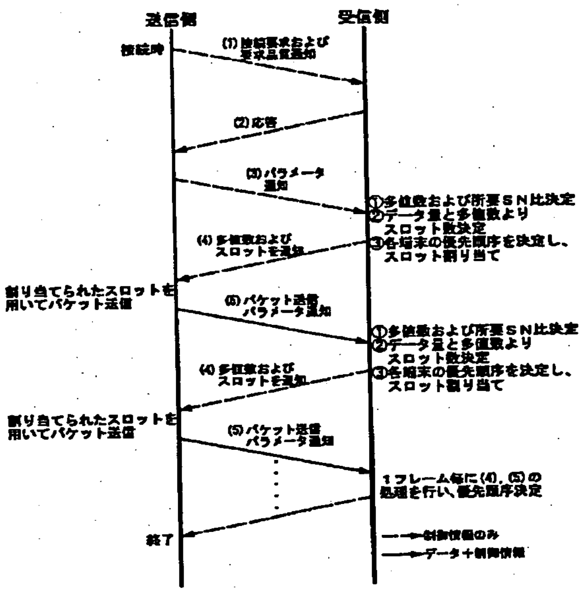
【図１４】

無線基地局が送信側、無線端末が受信側となる場合の
接続開始から終了までの流れの一例を示すシーケンス図



【図１５】

無線端末が送信側、無線基地局が受信側となる場合の
接続開始から終了までの流れの一例を示すシーケンス図



フロントページの続き

(72)発明者　梅田　成視
東京都千代田区永田町二丁目11番１号　株式会社エヌ・ティ・ティ・ドコモ内

Ｆターム(参考)　5K033 AA01 BA15 CB17 CC01 DA19
5K067 AA13 AA14 CC04 DD30 DD43
DD45 DD46 EE02 EE10 EE22
EE71 FF05 FF16 GG06 HH22
JJ02 JJ17 JJ21